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Effective supervision of doctoral students in public and population health in Africa: CARTA supervisors' experiences, challenges and perceived opportunities

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ABSTRACT



The quality and success of postgraduate education largely rely on effective supervision. Since its inception in 2008, the Consortium for Advanced Research Training in Africa (CARTA) has been at the forefront of providing training to both students and supervisors in the field of public and population health. However, there are few studies on supervisors' perceptions on effective doctoral supervision. We used a mostly descriptive study design to report CARTA-affiliated doctoral supervisors' reflections and perceptions on doctoral supervision, challenges and opportunities. A total of 77 out of 160 CARTA supervisors' workshop participants responded to the evaluation. The respondents were affiliated with 10 institutions across Africa. The respondents remarked that effective supervision is a two-way process, involving both supervisor and supervisee's commitment. Some reported that the requirements for effective supervision included the calibre of the PhD students, structure of the PhD programme, access to research infrastructure and resources, supervision training, multidisciplinary exposure and support. Male supervisors have significantly higher number of self-reported PhD graduates and published articles on Scopus but no difference from the females in h-index. We note both student and systemic challenges that training institutions may pursue to improve doctoral supervision in Africa.

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Background

The quality and success of postgraduate education and training largely rely on effective and efficient supervision (Mothiba et al., 2019). Supervisors are tasked with the responsibility to support and guide students to identify feasible research topics and questions, develop study protocols, provide oversight of the research process, complete their projects on time and to integrate candidates into academia (Kiley, 2011). However, what constitutes ‘effective’ supervision is relative and seems to be elusive to some. For example, there is no agreed definition of effective supervision, and different institutions have come up with ways of defining it based on their vision, mission, values and research outputs (Grant et al., 2014). Conceptualisation of effective supervision in the African context is also not clear, given that the models of doctoral education/supervision in many African universities continue to parallel those in the United Kingdom (UK) or European universities – programmes that are ill suited for the African realities (Cross & Backhouse, 2014). It is paramount to consider what effective doctoral supervision entails, particularly in African context, as well as the challenges that hinder quality supervision of doctoral students (Baptista & Huet, 2012).

Ladany et al. (2013) noted that quality supervision includes an expert in a given field guiding a doctoral student through conveying of garnered and useful information. In addition, Lee (2018) highlights five tenets of quality doctoral supervision: a functional role (setting milestones); enculturation; critical thinking; emancipation; and autonomy. Supporting this, other researchers have argued that the supervisor’s role is not only tied to the production of a scientific contribution but also a mentoring function – where candidates are introduced into the academic research community and supported to take up leadership positions (Manderson et al., 2017). However, the volume of information available means that a single expert may not know everything in his or her field (Paul et al., 2014). Furthermore, there is a move to more interdisciplinary approaches to research in response to complexity and the notion that more than one supervisor per student may be preferable (Fonn et al., 2016; Paul et al., 2014). With advances in research and changes in higher institutions of learning, what was initially construed as quality supervision may need to be reconsidered (Bøgelund, 2015).

Coincident with an expectation for high-quality postgraduate supervision, the supervisory role is becoming even more complex where supervisor and supervisee may differ in gender, ethnicity, culture, language, education and economic circumstances (Alam et al., 2013), as well as diversity in the nature and type of research. For example, the nature of supervisor interaction with students may largely be informed by their own background, knowledge, methods and experience (Dietz et al., 2006). This can be challenging especially when supervisors themselves are often the products of poor supervision, and do not, therefore, have experience of what constitutes effective supervision (Dietz et al., 2006; Manderson et al., 2017). Furthermore, supervisors may aspire to emulate perceived ‘best practice’ doctoral supervision; however, what constitutes ‘best practice’ is relative and may vary substantially by discipline, and may not meet the shifting needs of supervisees at different points in their candidacy (Manderson et al., 2017).

Such complexities are also inevitable in the African context (Guwatudde et al., 2013). For example, the rising student to staff ratios in many universities in Africa may, in practical terms, result in poor mentorship and supervision (Bacwayo et al., 2017), or larger classes with minimal time of interaction between students and supervisors (Guwatudde et al., 2013). In addition, a large number of prospective doctoral candidates are largely underprepared for doctoral studies – with limited research skills and inadequate academic writing capacity (Mouton et al., 2016). Heavy teaching and other academic workloads and poor pay may, in some cases, compel supervisors to multi-task, combining administrative, teaching and supervisory roles, to supplement their income, ultimately limiting their capacity to provide effective student supervision (Manderson et al., 2017).

Different strategies have been suggested to overcome these challenges. One of the key strategies is supervisor development (see Baptista & Huet, 2012), which can be done through supervisor

training or workshops (Manderson et al., 2017). Moreover, due to the fact that quality supervision is, in part, influenced by the calibre of doctoral students (Bøgelund, 2015; Friedrich-Nel & Mac Kinnon, 2019); assessing students' basic competencies e.g. knowledge-base, creativity, effective communication, positive attitude (Ophey & van Adrichem, 2016) or professional goals of a doctoral applicant (Young, 2014) may be helpful. This is largely what the Consortium for Advanced Research Training in Africa (CARTA) aims to achieve.

Established in 2008, the aim of CARTA is to provide training and to retain a vibrant African academy able to lead world-class multidisciplinary research that impacts positively public and population health (Ezeh et al., 2010). CARTA fellows and supervisors come from diverse disciplinary backgrounds, reflecting the multi-disciplinary mix of fields in public and population health (Fonn et al., 2016). The consortium provides extensive training to doctoral fellows that helps them to theorise and think critically and develop their cognitive competencies using a pedagogical approach that is student-centred (Fonn et al., 2016). The CARTA fellowship supports fellows for four years and includes formal teaching, mentorship, research support and opportunities to interact with an international academy. CARTA fellows have been reported to graduate in an average of 4.3 years with less than 4% attrition rate and they have raised over US\$18.5 million in grant funding up to the end of 2019 (Klugman, 2020). These numbers are exceptional even by global standards (Mouton et al., 2016).

In this article, we describe effective supervision as two-way interactional process that requires both the student and the supervisor to collaboratively engage each other within the spirit of professionalism, respect, open mindedness, to promote a favourable supervision environment. It is against this background that we aimed to document and present the findings of CARTA-affiliated doctoral supervisors' reflections and perceptions of their own supervision experiences, challenges and the impact of the CARTA programme in addressing some of these challenges. This is of interest to CARTA because the PhD fellows and supervisors come from a range of disciplines with a high likelihood of mixed expectations of doctoral supervision. This paper on supervisors' views augments the wealth of publications on PhD candidates' perspectives. It also provides useful insights into the feasibility and requirements for effective supervision in a multi-institutional and multi-disciplinary structured PhD programme in Africa (Igumbor et al., 2020; Uwizeye et al., 2020).

Methods

Study design and sampling

We used a mixed-method descriptive study design (Creswell, 2014; Schoonenboom & Johnson, 2017) to document CARTA supervisors' opinions. This design facilitated triangulation of study findings – using both quantitative and qualitative methods in answering the study objectives. It also helped to generate high-quality research by combining strengths and overcoming the respective limitations of each method (Creswell, 2014). We obtained ethical approval from the Human Research Ethics Committee at the University of the Witwatersrand (Ref: R14/49) to use anonymised data from CARTA supervisors' workshop routine evaluations.

A maximum of 30 participants, drawn from the consortium's nine universities and four research institutes across Africa, attend the CARTA supervision workshops in any given year. Supervisors of CARTA fellows, who are at their protocol finalisation stage of their PhD, are invited each year. The supervisor's workshop coincides with a CARTA Joint Advanced Seminars (JAS) designed to help PhD fellows develop their doctoral research proposals. This allows supervisors and supervisees to meet and review progress. The six-day supervision workshop is hosted by the School of Public Health, University of Witwatersrand, Johannesburg, South Africa. Experienced academics, drawn from CARTA member institutions, facilitate the workshops, mostly making use of group activities and a few structured presentations on key concepts. The details of CARTA strategies and activities

are extensively described in other publications (Ezeh et al., 2010; Adedokun et al., 2014; Fonn et al., 2016; Uwizeye et al., 2020).

While workshop participants were restricted to supervisors of CARTA doctoral fellows, more recently CARTA doctoral graduates, who are on the path to becoming PhD supervisors, have been included. The objectives of the workshop are to reflect on the requirements for doctoral supervision at different universities; improve the capacity of participants in their roles as supervisors; and share experiences on the different roles played by the institutions, the supervisor and CARTA in training doctoral fellows to become scholars, independent scientists, and research leaders. This article uses data from the evaluation completed by workshop participants from 2011 to 2017. A total of 160 participants had attended the CARTA supervision workshop during this period.

Data collection and tools

The evaluation utilised a semi-structured tool with a combination of open- and closed-ended questions. Particular to the closed-ended questions, the participants' level of agreement or satisfaction with various statements was measured using a five-point Likert scale. Most of the questions were about the participants' PhD supervision experience with all and any of their PhD students; a few questions were specific to their supervision of CARTA fellows. CARTA graduates with no PhD supervision experience were expected to skip questions not applicable to them. We extracted demographic information about the workshop participants and their institutional affiliations. In addition, we collected supervisors' peer review publication metrics available on the Scopus® website.

Data analysis

Descriptive analyses of demographic and other characteristics were performed to provide insights into the variances, frequencies, and percent distributions of participant characteristics and perceptions using the closed-ended evaluation statements. We compared median scores of male and female supervisors on various parameters using Mann–Whitney test and Poisson regression to identify factors associated with self-reported number of PhDs supervised to completion. Thematic analysis was used to analyse the open-ended data. The thematic analyses involved the key processes of familiarisation, indexing, charting, mapping and interpretation of key emerging themes (Braun & Clarke, 2018). To index and chart the data, the first two authors merged the codes into patterns of similarities and differences and aligned them to themes and sub-themes. They then discussed key categories with the last two senior authors who reviewed the data for further classifications. The data were shared with some of the workshop facilitators and participants to allow them to comment and verify our interpretation, thus increase its validity. To ensure the dependability of our findings, the second author re-coded the data, cross-checked the entire analysis process and ensured that discrepancies were resolved. Integrating data from open- and closed-ended questions enabled triangulation and verification of the study findings.

Results

Socio-demographics – Gender, institution of affiliation, academic disciplines

A total of 77 (34 females and 43 males) workshop participants responded to the evaluation survey indicating a response rate of 48%. The respondents were affiliated to ten institutions across Africa that included both universities and research institutes, as shown in Table 1.

A higher proportion of the respondents were from the University of Ibadan and Obafemi Awolowo University (both in Nigeria) and the University of Nairobi. Relative to the universities, a smaller number of respondents were from the research centres. This is expected,

Table 1. Demographic characteristics and affiliation of respondents.

Variable	Overall (n = 77)	Female (n = 34)	Male (n = 43)
<i>Median [IQR] age (years)</i>	n = 72; 53.0 (IQR:46.5–59.0)	n = 32; 53.5 (IQR: 43.5–59.5)	n = 40; 52.5 (IQR: 47.5–58.0)
<i>CARTA institution</i>			
Agincourt Population & Health Unit	1 (1.35%)	0 (0.00%)	1 (1.35%)
Ifakara Health Institute	1 (1.35%)	0 (0.00%)	1 (1.35%)
Makerere University	10 (13.51%)	2 (2.70%)	8 (10.81%)
Moi University	4 (5.41%)	2 (2.70%)	2 (2.70%)
Obafemi Awolowo University	13 (17.57%)	6 (8.11%)	7 (9.46%)
University of Ibadan	15 (20.27%)	7 (9.46%)	8 (10.81%)
University of Malawi	9 (12.16%)	4 (5.41%)	5 (6.76%)
University of Nairobi	12 (16.22%)	7 (9.46%)	5 (6.76%)
University of Rwanda	1 (1.35%)	0 (0.00%)	1 (1.35%)
University of the Witwatersrand	8 (10.81%)	5 (6.76%)	3 (4.05%)
<i>Faculty</i>			
Education	1 (1.37%)	1 (1.37%)	0 (0.00%)
Engineering	1 (1.37%)	1 (1.37%)	0 (0.00%)
Health Sciences	41 (56.16%)	21 (28.77%)	20 (27.40%)
Humanities	9 (12.33%)	2 (2.74%)	7 (9.59%)
Law and Management	2 (2.74%)	1 (1.37%)	1 (1.37%)
Sciences	7 (9.59%)	2 (2.74%)	5 (6.85%)
Others	12 (16.44%)	5 (6.85%)	7 (9.59%)
<i>Peer reviewed publication profile (medians)</i>			
Number of publications*	26 (12–55)	18 (12–41)	31 (10–58)
Total citations	233 (65–568)	230 (73–459)	347 (63–623)
h-index	9 (4–14)	7 (5–12)	10 (4–15)
Co-authors	74 (28–143)	56 (34–142)	80 (23–150)
<i>Preferred method of consultation with students</i>			
Contact (face to face)	57 (78.08%)	25 (34.25%)	32 (43.84%)
Email	9 (12.33%)	4 (5.58%)	5 (6.85%)
Other	7 (9.59%)	4 (5.48%)	3 (4.12%)
<i>Median [IQR] years of experience as a supervisor</i>	n = 71; 12.0 (8.0–20.0)	n = 31; 12.0 (5.0–20.0)	n = 39; 14.0 (9.0–20.0)
<i>Median [IQR] number of supervisees at Masters</i>	n = 63; 4.0 (3.0–7.0)	n = 26; 4.0 (2.0–7.0)	n = 36; 4.0 (3.0–6.5)
<i>Median [IQR] number of supervisees at PhD level</i>	n = 71; 3.0 (2.0–4.0)	n = 31; 3.0 (2.0–4.0)	n = 39; 3.0 (3.0–4.0)
<i>Median [IQR] number of PhD supervised to completion^a</i>	n = 66; 3.5 (1.0–7.0)	n = 27; 2.0 (0.0–4.0)	n = 38; 5.0 (3.0–9.0)

^aSignificantly different between male and female supervisors ($P < 0.05$).

because fewer numbers of doctoral fellows are drawn from research institutes and supervisors are mainly drawn from the universities in which the fellows are registered for their doctoral degree programmes. Makerere University in Uganda had a disproportionately higher number of male respondents. Slightly more than half (56.16%) of the respondents were from the Faculty of Health Sciences, followed by Humanities (12.33%) and Science Faculty (9.59%). The median age of the workshop participants was 53 years (IQR: 46.5–59.0), their median years of experience as supervisors was 12 years (IQR: 8–20) and they were currently supervising a median of 3 doctoral students (IQR: 2–4) and 4 master's degree students (IQR: 3–7) each. When analysing the data by gender there was no significant difference in the years of experience as supervisors and other measures in Table 1. However, male supervisors reported significantly higher self-reported median number of PhD students that they have supervised to completion (5 vs. 2; p -value < 0.05) and had a higher number of peer-reviewed publications (31 vs. 18; p -value < 0.05). Other than years of experience which may be collinear with the self-reported number of PhD students supervised to completion, gender of the supervisor was the only factor associated with the self-reported number of PhD students supervised to completion.

Modes and frequency of supervisor–supervisee contacts

Most of the respondents (78.08%) preferred face-to-face contact, while 12.33% of the respondents reported email as a mode of communication. A small number of the respondents indicated other modes of communication (9.59%) including a combination of methods.

The participants were asked how often they meet their PhD supervisee, almost half of all respondents (48.6%) reported meeting with students once every month, approximately sixteen per cent (15.7%) of the male and female respondents reported meeting fortnightly. A large proportion (25.7%) chose ‘Other’. The frequency of contact between supervisors and supervisees was further described by supervisor’s gender, as provided in [Figure 1](#). Female supervisors were more likely to choose ‘Other’. The respondents (males and females), who chose ‘Other’, remarked that the frequency of student contact varied based on student needs, stage of their PhD training and level of support required, or the availability of supervisors amidst competing responsibilities.

This study investigated supervisors’ perceptions on effective supervision, challenges experienced in supervision and strategies that can be used to improve doctoral supervision. We summarise the three overarching findings as follows: (1) Perceived strategies for effective supervision, (2) Challenges to supervision and (3) Impact of CARTA in addressing some of these challenges (see [Table 2](#)).

Perceived strategies for effective supervision

In the survey, participants reported different strategies for effective supervision. We present these responses at individual level (what was perceived to be the role of supervisors or students in enhancing effective supervision) and system level strategies (what could be done by the training institutions to enhance effective supervision).

At the individual level, more than three-quarters (78.5%) of respondents strongly agreed that providing timely feedback to students, continuous follow-up and motivating students were key during supervision. Seventy one per cent of respondents strongly agreed that the strategies should include setting timelines, ensuring student’s topic is researchable and developing a positive relationship between supervisor and student. About 30% of the respondents were either unsure or disagreed that supervisors should verify student funding or help them to choose a research topic (see [Table 3](#)).

The open-ended questions allowed us to understand what respondents considered important or how they approached supervision. Consensus in the views presented in the results are in spite of the multi-disciplinary background of the supervisors illustrated by the word cloud of topic areas and keywords supervisors published on (see supplementary information).

Having regular meetings with the students was reported as a way of ensuring effective supervision, and that effective supervisors needed to encourage students to devote more time to their work,

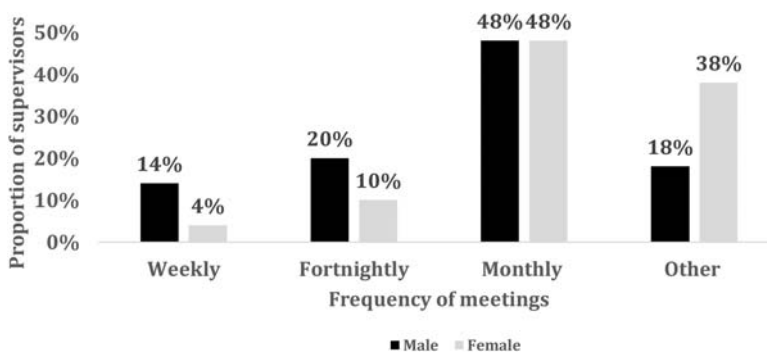


Figure 1. Frequency of supervisor–supervisee meetings.

Table 2. Summary of key themes and sub-themes.

Key finding	Sub-themes	
Perceived strategies for effective supervision	<i>Student/supervisor-related factors</i> Student/supervisors must have interest in research Timely feedback, regular student follow-up, and motivation for students Setting timelines Improve supervisor–supervisee relationships Supervision to be centred on student's needs	<i>Systemic factors</i> PhD Recruitment process Supervisor trainings Provide funding Improve infrastructure Offer exchange programmes
Challenges to supervision	<i>Student-related challenges</i> Lack of commitment/interest Insufficient funding Poor time management Poor writing skills Laziness and procrastination Not taking advice from supervisors	<i>Systemic and supervisor-related challenges</i> Limited supervision courses Limited support system for supervisors Limited infrastructure Inadequate supervisor training Supervisor financial challenges
Theme 3: Impact of CARTA program	<i>Impacts on students</i> Critical thinkers Higher calibre of students Improved writing skills Good completion time Provided resources/support	<i>Impacts on supervisors</i> Provided trainings Reduced supervision burden

as well as ensuring a positive supervisor–student relationship which included ensuring that students had sufficient access to their supervisor(s).

The students should be encouraged to devote more time to their programme. They should be given due or adequate attention by their supervisors and be well motivated. (Male, University of Ibadan)

Table 3. Individual-related strategies for effective supervision ($n = 67^a$).

	Strongly agree (%)	Agree (%)	Unsure (%)	Disagree (%)	Strongly disagree (%)
Provide timely feedback, follow-up and motivation	78.5	21.5	0.0	0.0	0.0
Set deadlines for reports/thesis	71.2%	25.8%	1.5%	0.0%	1.5%
Ensure students topic is researchable on available time	64.2%	32.8%	1.5%	1.5%	0.0%
Student/supervisor research interest should match	62.7%	31.3%	1.5%	4.5%	0.0%
Give students information about appropriate meetings	61.2%	32.8%	6.0%	0.0%	0.0%
Motivate students to work independently	58.2%	37.3%	1.5%	3.0%	0.0%
Students whose first language is not English should join courses	49.3%	37.3%	6.0%	6.0%	1.5%
Develop positive interpersonal relationship with student	37.8%	44.8%	4.5%	3.0%	0.0%
Supervision records well written, agreed and filled	44.8%	46.3%	9.0%	0.0%	0.0%
Verify student's financial resources for research projects	25.4%	43.3%	19.4%	10.4%	1.5%
Help students to choose research topic	17.9%	50.7%	13.4%	17.9%	0.0%

^aThe 67 respondents excluded the workshop participants who may not have the requisite experience or opinion on the evaluation statements.

Are supervisors easily available for consultation? Are they approachable? (Male, Obafemi Awolowo University)

Supervisor being non-judgemental was also reported as important.

Supervisor should not judge the students. They should work together to see how progress can be achieved even amidst the challenges. (Female, Makerere University)

Supervisors also reported systemic changes within their training institutions that would promote effective supervision. This included investing in infrastructure, improving supervisor training, improvements to the student recruitment process, and ensuring students have funds to carry out their research, as summarised in [Table 4](#).

Not only was supervisor training supported but it was noted that:

Formal regular training should be organized for both potential and experienced supervisors to improve their competences and communication during supervision. (Female, Obafemi Awolowo University)

Further refresher courses should be provided to all PhD supervisors. (Male, University of Malawi)

When respondents described what would constitute conducive environment for good supervision, a range of issues were mentioned. Beyond the obvious to African academics but perhaps not so obvious to supervisors in the global north such as internet access and a reliable electricity supply, respondents noted that they too needed access to training or learning experiences such as conferences where they could keep up to date with the content of their field and new analytic approaches and tools to improve their own academic writing skills. In particular, they felt their institutions should ensure that supervisors had access to data analysis programmes:

There is need for supervisor exposure to more recent data analysis techniques and software; and support for higher exposure of research findings through better academic writings. (Male, University of Ibadan)

Financial support (for both students and supervisors) was also reported as a key factor that could promote effective PhD level training:

Universities should take responsibilities for supporting researchers [students] financially and provide skills that are lacking. (Female, Obafemi Awolowo)

There should be funding support for supervisors to attend further training because what you don't have you cannot give. They should also be provided with laptop and up-to-date software. (Male, Obafemi Awolowo)

Student recruitment processes were said to be important in influencing the calibre of students selected for PhD programmes, and also ensuring a good fit between the supervisor and supervisee:

Effective supervision requires a strict selection criterion that needs to include prospective student and supervisor, face to face interview, clear demonstration resources required etc. (Male, University of Nairobi)

Having laid down policy guidelines and contracts that could guide both students and supervisors were said to enhance effective supervision:

There's need to have clear guidelines and quality assurance measures on the supervision process. (Female, Moi University)

Table 4. Respondents opinion on structural improvements for effective supervision.

	Strongly satisfied/ agree (%)	Agree (%)	Unsure (%)	Disagree (%)	Strongly disagree (%)
Invest in infrastructure (<i>n</i> = 64)	51.6	29.7	14.1	0 (0.0)	4.7
Supervisor training (<i>n</i> = 65)	49.2	43.1	6.2	0 (0.0)	1.5
PhD Student recruitment process (<i>n</i> = 71)	35.2	49.3	15.5	0 (0.0)	0.0
Student stipend (<i>n</i> = 70)	28.6	41.4	28.6	0 (0.0)	1.4
Research costs associated with studentship (<i>n</i> = 70)	28.6	34.3	25.7	6 (8.6)	2.9

Both supervisors and supervisee must sign a contract that shows their roles and responsibility. (Female, University of Malawi)

Issues around having a co-supervisor were also raised by many as an important factor to consider for effective supervision. This was largely related to the nature of the multidisciplinary approach of public and population health PhD programmes that could require expertise from other fields:

There's team supervision where supervisor and co-supervisor will share experiences that are more beneficial to the student, than where supervision is done by one supervisor. (Female, University of Malawi)

Interestingly supervisors suggested that there was a need for an exchange of ideas between supervisors at different universities in order to learn from each other.

There should be opportunity for the supervisors to share ideas based on their different experiences in PhD supervision through a shared forum. (Male, University of Ibadan)

Challenges to supervision

Respondents provided feedback on challenges to effective supervision. The responses reflected supervisors' experience with supervision in general, and were not specific to challenges of supervising CARTA PhD fellows. We classified these challenges as student-related challenges, systemic and supervisor-related challenges. Table 5 shows the responses from the survey on challenges to supervision from 67 participants who responded to the questions in this section. Forty-three per cent of the respondents strongly agreed that lack of commitment and interest, poor time management and overall organisation were key challenges to supervision.

Student-related challenges. The open-ended questions revealed that the motivation to do a PhD was in question because: 'Some of the students are not really interested in the PhD programme, they will just enrol for one because there are no jobs.' (Female, Obafemi Awolowo University).

Inadequate funding for the research itself was reported to impact negatively students' commitment to research work:

If the research costs are above that [funds] which is provided, the student is left in a fix especially if they do not have other funding. (Female, Makerere University)

The money provided [to the student] was not enough to cover for the research, student had to find some other sources ... (Female, University of Nairobi)

Student's poor time management, poor writing and language skills were also perceived to limit effective supervision. As such, participants recommended that weak students – those who were not strong in theory or specific research methods should be encouraged to join existing (taught) courses often available in the undergraduate or masters curriculum during their PhD studies.

Table 5. Respondents opinions on PhD student-related challenges to supervision ($n = 67$).

	Strongly agree (%)	Agree (%)	Unsure (%)	Disagree (%)	Strongly disagree (%)
Lack of commitment and Interest	43.3	41.8	3.0	10.4	1.5
Poor time management and overall organisation	34.3	61.2	0.0	1.5	3.0
Lack of financial support	30.9	47.1	11.8	8.8	1.5
Poor writing and language skills/ inadequate numeracy skills	31.8	43.9	13.6	9.1	1.5
Laziness and procrastination	31.3	38.8	11.9	16.4	1.5
Students don't take advice/communicate with supervisors	19.4	56.7	11.9	9.0	3.0
Lack of independence	13.4	37.3	22.4	25.4	1.5

Systemic and supervisor-related challenges. More than half of participants (64.7%) reported that they did not have supervision courses in their institutions. In the open-ended questions, one respondent reported that:

We don't have supervision courses or guidelines on what we must do. (Male, University of Ibadan)

In relation to this, 57.4% of respondents reported that they lacked adequate institutional support systems in their universities such as training and travel to enable them to improve their supervisory skills and experiences:

There is no organized support system for supervisors to further enhance their capacities in my institution. Funding supports to attend international conferences/workshops to present their research findings are not there and each person most often look for his/her own financial assistance and which are mostly not available. This hinders quality supervision. (Female, Obafemi Awolowo)

Inadequate university salaries or financial challenges experienced by some supervisors were reported to compromise the quality of supervision:

... those [supervisors] struggling financially may devote more time in looking for extra jobs and finances to supplement their income, which may limit their capacity to supervise. (Female, Makerere University)

Impact of CARTA programme in addressing some of these challenges

At the end of the survey, participants were asked if or how CARTA activities have affected students and supervisors.

Training and research funding to students. The CARTA programme was reported to have enhanced students' critical thinking, improved their writing skills, and timely completion of doctoral training when compared with non-CARTA fellows. As a result, supervisors mentioned that they had an easier time supervising CARTA fellows compared to non-CARTA students. They added that CARTA fellows are better trained to comprehend complex ideas and communicate effectively in the supervisor-supervisee interactions and execute their PhD research with greater efficiency thus alleviating the burden of supervision and its quality:

They [students] think creatively, they are critical in their engagement with evidence. (Female, Wits University)

They have better knowledge and skills on writing, their exposure to multidisciplinary facilitators and students from other universities challenges them, they are more receptive to mentoring [...]. (Female, Obafemi Awolowo University)

Supervisors also reported that CARTA fellows; work was of good quality, and students largely finished their studies in good time compared to non-CARTA fellows:

The content of the JAS trainings is very comprehensive and its impacts on fellows' quality of work are quite evident based on the students that I have interacted with. (Female, University of Malawi)

CARTA is doing a good job for the students; I see the students finishing on time. (Female, University of Nairobi)

The tradition of having a single supervisor was reported to be a liability that CARTA relieved:

I deeply appreciate the contributions of CARTA to my students' work. It reduced the burden of being a lone supervisor. I had more time to spend with my students who are not on the CARTA programme. (Female, Obafemi Awolowo University)

Supervisors also reported that research funding and travel allowances provided to CARTA students were helpful in enhancing the completion of projects, commitment and interaction with other students. This also helped in fostering independence amongst students, which was helpful during the supervision process:

I think CARTA program is well structured and gives the opportunity for a student to benefit from various support, human and material resources, close and planned supervision, peer learning through the joint advanced seminars are all important for effective learning. (Female, University of Malawi)

Supervisor training workshops. Supervisors reported that the workshops that CARTA provided enhanced their supervision skills and made clear the roles expected of supervisor and supervisee:

This is an excellent programme. Well developed, particularly the in-built trainings and involvement of supervisors. (Male, University of Ibadan)

Based on the aforementioned positive experiences, many participants recommended that CARTA support activities (such as its selection process, the structured training – for PhD fellows and supervisors – milestones, funding opportunities, access to research infrastructure and amenities, and the international and multidisciplinary exposure, interactions and mentorship opportunities), should be rolled out in home institutions to facilitate PhD supervision:

Partner institutions should raise the profile of the CARTA approach in their various campuses to increase the level of competition and quality of PhD student and graduates. (Female, Obafemi Awolowo)

There is need to increase awareness and scope of training to other faculties and department other than public health. Training should be extended to non-CARTA supervisors by organising local training at the member universities. (Male, University of Ibadan)

Discussion

This study investigated supervisors' reflections and perceptions on doctoral supervision, their overall challenges and how CARTA addressed some of these challenges. This is in addition to soliciting their views on the requirements for affective supervision. This study was limited to CARTA-affiliated supervisors; it may not reflect the experience of all supervisors or other institutions. However, the similarity of our findings with those reported by others suggests that there is some generalisability of the findings. In what follows, we discuss the key findings from this study in relation to the existing literature.

Firstly, effective supervision was considered to be a two-way process, involving both supervisors and the supervisees. This required a clear and positive relationship between the two parties, including scheduling of regular meetings to enhance understanding of research progress, and provision of regular forum for advice and academic assistance, as reported elsewhere (Van Rooij et al., 2019). Similarly, Cloete et al. (2015) have emphasised that guidance, leadership and the quality of feedback provided to students are key in effective supervision. In addition, findings from this study showed that both supervisors and students need to have a positive collaboration by expressing their interests, expectations and clearly stipulating each other's responsibilities, as reported elsewhere (Halse & Malfroy, 2010; Uwizeye et al., 2020), and that supervisors must have competence and intellectual depth (Chiappetta-Swanson & Watt, 2011). Our study extends this position by supervisors reporting that well-prepared students can articulate and execute the complexities of a PhD and that the CARTA JAS's with its multi-disciplinary pedagogy and exposure enabled this.

Secondly, understanding of supervisor–supervisee roles and responsibilities was considered as one way of ensuring effective supervision. In this regard, supervisors reported the importance of having explicit policies and guidelines that would guide both supervisors and supervisees. This finding concurs with earlier studies from CARTA which have highlighted the role that the formal CARTA student–supervisor contract, signed by each party played and this too has been noted by others (Manderson et al., 2017; Gill & Burnard, 2008). This formal agreement aims to govern supervisory relationships, provides a clear and shared understanding of obligations, rights, responsibilities and opportunities to build an effective relationship between the two parties. Murphy and colleagues have argued that, in the absence of clear expectations and understanding of roles,

problems with supervision occur (Murphy et al., 2007). Thus, policies and guidelines that help both supervisors and students to commit to their roles and responsibilities as well as holding each other accountable seem beneficial and could be actioned at each institution.

Thirdly, effective supervision was perceived to encompass a good working environment with adequate resources, support for supervisors to attend conferences or workshops and ensuring that supervisors were exposed to up-to-date contents (see also, Emilsson & Johnsson, 2007). Regarding this, supervisors' training was reported by all participants as one way supervisors can develop their own research skills, enhance their role as supervisors and offer quality supervision. This is perhaps a problem more common in low- and middle-income countries where higher education institutions are insufficiently funded and research supportive environments are limited (Fonn et al., 2018). Dietz and colleagues have also argued that many supervisors lack the conceptual map of what constitutes acceptable supervision (2006). Thus, supervisor development through training – in both research and mentoring skills, is an important component of effective doctoral supervision (Kumar & Johnson, 2017).

Co-supervision was also reported as one way of ensuring effective supervision. This was particularly reported in line with the complexities of doctoral programmes e.g. interdisciplinary or multi-disciplinary PhD programmes that may require a close collaboration between supervisors in different fields and also, between supervisors and students (Maher & Say, 2016). Respondents in this study pointed out that having more than one supervisor would facilitate different experts or opinions, reduce supervision work and improve quality of students' work. Other researchers have reported that co-supervision improves supervisor–student interaction, promotes the development of rigour, improves quality of work (Paul et al., 2014), and may be useful in reducing the risk of supervisory incompetence (Rugg & Petre, 2004).

In this study supervisors indicated that student-related factors, such as interest to pursue a PhD programme, were key considerations for effective supervision. For example, the finding that students decided to do a higher degree as a fall-back because there were no job opportunities may be more common in SSA where unemployment is high (Baldry, 2016). Furthermore, some students were reported to display poor time management, poor writing skills and had insufficient funding. However, this may not be specific to SSA as it has been reported elsewhere that students' preparedness to undertake doctoral studies, attitudes and other competing social and economic factors can influence effective supervision (Ophey & van Adrichem, 2016). While selecting PhD students in a more rigorous manner may deal with some of these problems, it seems unlikely that one can screen out all 'undesirable' characteristics. It also seems irrational to expect someone entering a PhD programme to have all the skills and the financial means prior to the programme. It is often such programmes that impart these very skills and opportunities. It seems that PhD programmes must be structured to build these skills and that supervisors need to be able to identify what the supervisee needs are and assist them in gaining skills and accessing resources. This implies that supervisors have to tailor their support of supervisees to the individual needs of each student as has been noted elsewhere (Manderson et al., 2017). It is worth mentioning that the report of CARTA fellows being better prepared and finishing their PhDs on time is anecdotal and may be true for some fellows but does not necessarily apply to all CARTA fellows. A formal comparison between CARTA fellows with non-CARTA fellows needs to be done to confirm if this impression is correct.

System level factors, such as lack of supervision courses, support systems (Ophey & van Adrichem, 2016), and limited infrastructure, emerged as key impediments to effective supervision (Backhouse, 2009). Studies have illustrated that universities and research institutions in Africa face particular challenges, including supervisors managing large classes of undergraduate and graduate students, limited time for individual supervision and a lack of supervisor motivation (Guwatudde et al., 2013). This is not uniform across Africa and within our cohort; some universities are better able to provide resources and supervision courses than others. The request from many of the supervisors for better support, such as access to literature, research infrastructure, including software and opportunities, to renew their own skills all point to the lack of research supportive

environments in the African academy (Morel et al., 2018). It is perhaps not surprising that supervisors at the CARTA workshop mentioned these issues because, during the workshop, supervisors are apprised of the CARTA programme and get to understand the support offered to CARTA PhD fellows. This includes a computer loaded with software analysis programmes, academic writing support, funds to attend conferences and access to the literature as well as structured teaching and mentorship. These are resources that many academics working in African universities do not have, yet they are expected to supervise and mentor young researchers. Even the request by some for a monetary incentive to spend more time on supervision has to be seen in the light of the inadequate resources and low salary level of the majority of African academics who are obliged to supplement their income (Guwatudde et al., 2013). Given these challenges, supervisors recommended that there should be platforms for them to engage with other supervisors in conferences or workshops, to share ideas about best practices in doctoral supervision. Such exchange of ideas may not only contribute to the individual's academic career but create multiplier effects for students, the department, and the institution.

A peculiar finding of this study was the role of supervisor's gender in the self-reported number of PhD graduates produced and would require further investigation. We found no statistical difference in the male and female supervisors' age, years of experience, h-index and the number of co-authors in their publications. A higher proportion of female supervisors also reported that they meet their PhD students as often as needed, similar to what was reported elsewhere (Hindes & Andrews, 2011), yet female supervisors have significantly fewer number of objectively counted peer review publications and self-reported number of PhD graduates produced. This difference, as described by Johnson et al. (2000), has been associated with the conflicts in women's identities as scholars and gendered beings. They offered detailed elements for pedagogies of training scholars to mitigate gender biases, role clarification, identify formation and gender conscious knowledge production among scientists. The excerpts from our female respondents further underscore their emphases on PhD training structure, process and quality, and nurturing of supervisees. This point may be supported by lack of significant difference in h-index by gender despite the male supervisors having more publications.

Conclusion

This study builds on earlier research on effective doctoral supervision and highlights the requirements for effective supervision in Africa. It points out that effective supervision relies on both supervisors and students and the context where the research and supervision is taking place – research supportive environment is urgently required. Effective supervision requires both parties to meet regularly and reflect on their relationships, responsibilities, timelines and interests. A shift towards interdisciplinary approaches to research should be cognizant of the importance of co-supervision. Supervisors must also identify individual student's needs and expectations in doctoral programme so that they can design supervision models that fit each student's requirements. Our findings also invoke likely gender differences in PhD supervision and the potential need for balancing of attributes. Overall, there is need to refine capacity building interventions and doctoral training programmes to mitigate some of the challenges reported in this study while harnessing the opportunities. Lastly, higher education institutions and systems must make investments to support research and research training in Africa.

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