Perceptions of the Research Integrity Climate in Egyptian Universities: A Survey Among Academic Researchers

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Abstract

Problem: Investigations regarding perceptions of the institutional research integrity climate in the Arab Middle East remain underexplored.

Subjects: We surveyed faculty from three Egyptian universities.

Method: We utilized the Survey of Organizational Research Climate (SOuRCe) tool, which incorporates seven subscales that measure different aspects of the research integrity climate. Responses were obtained from a 5-point Likert scale.

Findings: Of the 228 participants, the subscales 'Regulatory Quality' and '[Lack of] Integrity Inhibitors' received the highest mean scores, whereas the lowest scores pertained to 'Departmental Expectations,' 'Integrity Socialization,' and 'Responsible Conduct of Research indicating areas in need of improvement.

Conclusions: Academic leaders should set fairer expectations for research and funding for their researchers, ensure junior researchers are socialized into research integrity practices, and promote effective RCR training and availability of RCR policies. We identify specific targeted interventions to enhance the research integrity climate within these institutions.

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Background

The last few decades have witnessed a global increase in research productivity (El Rassi et al., 2018). During this period, research activity in the Arab region has increased significantly (El Rassi et al., 2018), as countries in this region have been favored destinations for clinical trials (Machaalani et al., 2022; Marzouk et al., 2014). However, increased research misbehaviors represent a potential concern with the enhanced research activity (Al-Adawi et al., 2016; Felaefel et al., 2018). Such behaviors that include data falsification and fabrication, plagiarism, and the more frequent questionable research practices (Martinson et al., 2005) are likely to threaten the reputation of academic institutions, decrease the credibility and integrity of research results, harm research participants, and undermine public trust in science (Finlayson, 2006).

One factor leading to research misconduct includes the individual's personality characteristics (Shaw, 2019; Sovacool, 2008; Steneck, 2002, 2006). Recently, there has also been a focus on the importance of the organizational research climate that can influence ethical decision-making and ethical behaviors related to the responsible conduct of research (RCR) (Kisamore et al., 2007; Mumford et al., 2007). The research climate is "*the shared meaning organizational members attach to the events, policies, practices, and procedures they experience and the behaviors they see being rewarded, supported, and expected*" (Ehrhart et al., 2014). Specifically, elements of the organizational research climate include the organization's structures, processes, policies, and procedures.

Several studies indicate that the perception of the research integrity climate might be associated with downstream effects on research behaviors (Anderson, Horn et al., 2007; Crain et al., 2013; Daft, 2015; T. Haven et al., 2021; Martinson et al., 2006, 2010). For example, Crain and colleagues (2013) documented associations between researchers' self-reported behaviors and various features of organizational environments. Furthermore, a recent meta-analysis by Xie et al. (2021) demonstrated a significantly higher prevalence of self-reported research misconduct in LMICs compared with Western countries. Additionally, Fanelli et al. (2015) showed a higher frequency of retractions (as a proxy of research misconduct) for authors from countries with limited research integrity policies. In addition, encountering specific environmental factors such as inadequate mentoring, insufficient educational opportunities, competitive pressures, substandard supervision, and ineffective peer interactions can be precursors to research misconduct, as Mumford (2007) identified.

Recognizing the importance of the organization's climate has led to efforts to measure the research integrity climate that would allow organizations to benchmark baseline conditions, target areas of the climate that can be changed, and evaluate the impact of subsequent initiatives. To enable such an assessment and feedback approach, Martinson and colleagues (2013) developed and validated their Survey of Organizational Research Climate (SOuRCe)

tool to measure respondents' perceptions of their research integrity climate that supports responsible research practices. The SOuRCe is a self-assessment tool incorporating seven subscales measuring different aspects of the research integrity climate.

The theoretical background of the SOuRCe tool relies on an "open systems" framework that recognizes research integrity as an outcome of processes influenced by multiple factors related to the organization's visible ethical leadership, socialization and communication processes, and the presence of policies, procedures, structures, and processes that include reward and performance evaluation systems, employee code of conduct manuals, and other formal documents to deal with risks to integrity (IOM report, 2002; Martinson et al., 2013; Webber, 2007). The SOuRCe is additionally grounded in an organizational justice framework that includes individuals' perceptions of the "fairness" of actions regarding research integrity (Martinson et al., 2010). Specifically, if members of academic institutions perceive injustice in their organization, they are more likely to take on behaviors that compensate for the perceived unfairness. Hence, in a research climate where perceived injustice is high, researchers would be more likely to engage in intentional research misconduct (falsification, fabrication, and plagiarism) or questionable research practices (T. L. Haven et al., 2019).

Studies have used the SOuRCe tool to assess the research integrity climate across departments, fields of study, and academic rank (faculty, postdoctoral scholars, and graduate students) in several countries (Armond & Kakuk, 2022; T. L. Haven et al., 2019; Iutcovich et al., 2003; Mumford et al., 2007; Wells et al., 2014). For example, Wells and colleagues (2014) pooled data from three universities in the U.S. and showed significant differences in all seven subscales of the SOuRCe tool by academic rank. These investigators also found significant differences in the perceived research climate between different scientific disciplines. In another study, Haven and colleagues (2019) used the SOuRCe tool to assess the research integrity climate at institutions in Amsterdam and found differences regarding the perception of the research integrity climate between academic rank and scientific fields. Finally, Armond and Kakuk (2022) explored the perceptions of the research climate in three universities in Hungary and found that Ph.D. students and full professors perceived the research climate more positively than postdocs and assistant professors. They also showed that researchers in the biomedical sciences perceived regulatory bodies to be fairer when evaluating their projects than those in the natural sciences. One of the conclusions of these investigators included that institutions should focus more on early-career researchers, particularly postdocs and assistant professors.

While studies have investigated the research integrity climate in countries with developed economies (upper-middle and high-income countries), studies exploring the research integrity climate are absent in Low- and Middle-Income Countries (LMICs). The research integrity climate in LMICs differs from the countries studied in the previously mentioned investigations, given the different extent to which organizational structures and policies might focus on research integrity. Additionally, the sociocultural and political backgrounds of the countries where LMIC universities are situated might also determine the research integrity climate (Antes et al., 2018; Davis, 2003; Muchinsky, 2004; Mumford et al., 2007). Accordingly, we aimed to adapt the Survey of Organizational Research Climate (SOuRCe)

tool for application within Egypt, which is categorized as a Lower-Middle-Income Country (LMIC) in the Arab Middle East. Our specific objectives were:

1.   To evaluate the perceptions of the research integrity climate among researchers at three Egyptian universities offering doctoral programs.

2.   To investigate variations in perceptions of the research integrity climate based on respondents' academic profile (e.g., academic rank, department type, and publication output).

3.   To compare our results with those of the United States, the Netherlands, and Hungary, where the SOuRCe tool was previousy lutilized.

Methods

Study Design:

We conducted a cross-sectional questionnaire study to investigate the research integrity climates in three academic institutions in Egypt.

Participants and Recruitment:

The questionnaire was administered via a web-based survey (SurveyMonkey) between April and Dec. 2022 at the three universities. We targeted only individuals who would have had adequate exposure to the research environments in their universities. Accordingly, we obtained comprehensive listings of the following academic ranks:

•   Demonstrators pursuing a master's degree.

•   Assistant lecturers pursuing a Ph.D. degree.

•   Lecturers with Ph.D. degrees and are now faculty members.

•   Assistant professors with published research.

•   Professors with published research.

Description of Participating Universities:

The three surveyed universities are Egyptian public universities supported by governmental funding and focused on teaching and mentoring students. They all offer bachelor's degrees, master's, and doctorate programs in biomedical sciences, social sciences, engineering, and humanities. These three universities are consistently ranked within the top 25 universities in Egypt in published surveys (Universities in Egypt - Rankings & Reviews, 2023).

All faculty members must perform research and mentor graduates to obtain promotions. Research funds for research are based on written projects funded by different government sectors or private sponsors.

Survey tool:

The survey included an information sheet that described the purpose of the study, emphasized that the responses would be collected anonymously, and provided instructions on completing the survey.

The survey also contained a demographics section that included gender and factors specific to academic universities: highest scientific degree, academic rank, discipline type, number of publications, and a mentoring role with students. This section was followed by the Survey of Organizational Research Climate (SOuRCe) questionnaire. This questionnaire includes 32 items. The first four items represent a relatively generic global perception scale and consist of two items that assess the global perception of the institutional environment and another two that assess the global perception of the department or program. The remaining 28 items are divided into two parts, with seven subscales assessing specific research integrity climate characteristics. The first part contains 11 questions involving the perception of the research climate in the broader institution. The remaining 21 items inquire about individuals' perceptions of the research integrity climate in their local environment, e.g., department or program.

The seven subscales assess the following areas:

(1) Responsible conduct of research (RCR) Resources - Institutional Level (6 items). Respondents' perceptions of effective educational RCR opportunities, the accessibility of research resources (e.g., policies and experts), understanding of misconduct reporting procedures, and academic leaders who support RCR.

(2) Regulatory Quality: Institutional level (3 items). Respondents' perceptions of the degree to which research regulatory committees treat researchers fairly and how familiar research ethics committees are with the research they review.

(3) Integrity Norms: Departmental level (4 items). This scale assesses perceptions of the degree to which norms about research integrity (e.g., honesty, confidentiality, scholarly integrity) exist in one's department.

(4) Integrity Socialization: Departmental level (4 items). Respondents' perceptions of departments' activities that effectively socialize junior researchers in aspects of research integrity.

(5) Advisor /Advisee Relations: Departmental level (3 items). Respondents' perceptions about the relations between supervisors and their supervisees regarding fairness, respect, and availability (the strength and quality of the mentoring relationship).

(6) [Lack of] Integrity Inhibitors: Departmental level (6 items). This scale measures perceptions of the department's lack of adequate resources (e.g., lack of human or material resources), pressures to publish, and competition among researchers that produce challenges to conduct research responsibly. This scale was reversed scored so that the direction of the scores can be interpreted using the same logic as the other subscales (i.e., a higher

score denotes a more significant lack of inhibiting factors, which indicates a better research integrity climate).

(7) Departmental Expectations: Departmental level (2 items). This scale assesses the perceptions of the fairness of the departmental expectations for publishing and obtaining external funding.

The responses consisted of a 5-point Likert scale: (1) not at all, (2) somewhat, (3) moderately, (4) very, and (5) completely. A sixth option, "no basis for judging," is offered to avoid forcing a response about a specific level of perception where none exists.

Survey Validation Methods

The SOuRCe tool was previously developed and validated to assess the organizational climate of research integrity in U.S.U.S. academic settings and then used in universities in the Netherlands and Hungary. We performed the following methods to adapt the tool to the Arabic region in the Middle East.

Content validity: We established a content expert panel to evaluate the extent to which the items in the questionnaire adequately reflect the theoretical constructs the questionnaire was designed to measure. This panel also assessed the questionnaire for clarity and relevance to the Arab university setting and evaluated the overall comprehensiveness of measuring the constructs. Based on their comments, we slightly altered the wording of several items (see Additional file 1).

Cognitive interviews: We recruited ten respondents to assess the comprehension of questionnaire items and response choices, retrieval of appropriate information from long-term memory, judgment based on comprehension and retrieval of information, and selection of response. This was performed in three rounds of interviews (three from each university); analysis of results and modification of questionnaire items followed each round.

Sample Size and Technique:

We calculated the sample size of 228 participants based on a margin of error of 5% and a confidence level of 95%.

Data Analysis:

We assigned point values to each of the five response items (1 = 'Not at all, 5 = 'Completely'); zero points to the sixth option, "No basis for judging," that was offered to avoid a forced response. We computed mean subscale scores by averaging the five response items within each subscale. The "Integrity inhibitors" subscale items were reverse coded so that higher scores could be interpreted as more positive perceptions across all subscales. The mean scores of each subscale could range between 1.0 to 5.0.

Scores were included only for individuals who responded to at least half of the items for a given scale. We excluded questionnaires in which respondents gave the same response for every SOuRCe item (i.e., "response-set" in standard survey nomenclature), as this typically

indicates a lack of genuine engagement and thoughtfulness in the response process, yielding meaningless responses.

The data were coded and exported into Microsoft Excel, version 2013. We analyzed the data using the statistical package for social science (SPSS version 21).

We computed mean scores across the seven subscales of the SOuRCe tool: Responsible Conduct of Research (RCR) Resources, Regulatory Quality, Integrity Norms, Integrity Socialization, Advisor-Advisee Relationships, Integrity Inhibitors, and Departmental Expectations. We then stratified these scores based on gender, academic rank, departmental affiliation, involvement in mentoring junior researchers, and publication count.

We employed basic descriptive statistical methods to analyze the quantitative data. We assessed the reliability coefficient for each subscale by using Cronbach's alpha. Associations between independent variables and the SOuRCe subscales were determined by the Comparison of the Means Test. To identify the significance of the data, the Kruskal-Wallis test was used by analyzing the means of within and between groups. We calculated values of skewness and kurtosis to test the normality of a given data set. A p-value of <0.05 was considered statistically significant.

Ethics Approval: We obtained ethics approval from the research ethics committees of each participating Egyptian University and the University of Maryland School of Medicine HP-00094497. The specific names of the Egyptian Universities were given to the journal editor but are omitted in this manuscript to preserve their privacy.

Informed consent: Participants accessed an online information sheet that described the study's purpose and design and emphasized that the responses would be collected anonymously to protect their privacy.

Results

We collected 288 responses from the three targeted public universities in Egypt, from which 60 were excluded due to inadequate or "meaningless" responses, leaving 228 responses that served as the basis of our analysis. Three-quarters of our respondents were females (75%).

Nearly half of our respondents were master's or Ph.D. students (23.2% and 22.4%, respectively). Slightly more than a quarter were lecturers (27.6%), and slightly less than 15% were either assistant professors or professors. Many of our respondents reported involvement with mentoring graduate students (59.8%). Regarding academic disciplines, 60.5% were from clinical sciences, 31.1% from the basic medical sciences (31.1%), and 8.33% from dentistry (see Table 1 for additional details).

Table 2 shows the mean scores of all the survey items and for each of the SOuRCe subscales, the number of cases, the number of scales' items, and the reliability coefficients, the upper and lower limits of the confidence intervals, and the tests for normality of the data.

Scales were scored from 1 to 5, reflecting the average scores of its constituent items. The total mean score was slightly less than 3.00 (2.98 ± 0.65). The highest mean scores were achieved in the "Regulatory Quality" and "Integrity Inhibitors" subscales (3.48 ± 0.89 and 3.48 ± 0.83, respectively), while the lowest scores were obtained for "Departmental Expectations" and "Integrity Socialization" (2.53 ± 1.03 and 2.83 ± 0.92, respectively). The "RCR Resources," "Integrity Norms" and "Advisor/Advisee Relations" subscales had scores that ranged between 2.98 and 3.24.

The Cronbach's alpha scores ranged from 0.72 to 0.89, indicating good internal reliability. The values of skewness should be under ± 1 for the data to be considered normal. Table 2 shows that all the values of skewness are under 0.5. The acceptable range of Kurtosis should be under ± 2 for normality. Table 2 shows that the Kurtosis data values are all under the acceptable range. Therefore, it is concluded that data is normally distributed.

Table 3 shows the associations between gender and academic factors and mean scores of the SOuRCe subscales. No differences were observed in the subscales for the academic rank categories and the different scientific disciplines. The analysis regarding mentoring students showed significant differences in the two subscales. Compared with those without such a role, participants with an active student mentoring role scored significantly higher in the "Advisor/Advisee Relations" and "Regulatory Quality" subscales. The academic factor "the number of publications" was significantly related to Advisor/Advisee Relations. On multiple comparisons testing using Tukey's test, participants with>20 publications scored higher on this subscale than those with None or 1-5 publications.

Discussion

This is the first study to use the SOuRCe tool to investigate the perceptions of the university's research integrity climate among academic researchers from an LMIC in the Arab Middle East. We also found it was feasible to implement the SOuRCe in several large academic institutions in Egypt across a broad range of academic levels and department types.

Individual Subscale Scores

Subscale scores ranged between 2.53 for Departmental Expectations and 3.48 for Regulatory Quality and [Lack of] Integrity Inhibitors. The other subscales clustered around 3.0. A mean value below 3.0 generally suggests that the respondents leaned toward a lower perception of the existence of the item in question. Conversely, a mean value above 3.0 would indicate that, on average, respondents are more likely to agree or strongly agree that the item exists or is effective. Finally, a mean value close to 3.0 can be interpreted as a neutral or mixed response.

The mean score of 2.53 for Departmental Expectations signals a relatively higher perception of organizational pressure among respondents to publish and secure funding, which could imply a concerning level of organizational pressure without directly pointing to significant organizational injustice. The relevance of this finding is underscored by research performed by Martinson and colleagues (2010), who found that negative views on organizational

justice (i.e., being treated fairly) correlate with self-reported misbehavior and misconduct. Additionally, unlike findings from Amsterdam and Hungary, where early- to mid-career scientists reported greater pressure compared to their senior counterparts (Armond & Kakuk, 2022; T. L. Haven et al., 2019), our study found no such variation across academic ranks in Egyptian universities. Our knowledge of the Egyptian context suggests that such uniformity could stem from several factors: a pervasive job market pressure affecting faculty at all levels, an academic culture that demands high output from everyone, limited financial resources impacting all staff equally, or the possibility that those typically resistant to such pressures—tenured professors—constituted a minor segment (<15%) of our respondents.

The highest scores of 3.48 were attached to Regulatory Quality and [Lack of] Integrity Inhibitors. The Regulatory Quality subscale typically measures participants' views on how fair and respectful regulatory committees (e.g., RECs) are with them and how familiar they are with the research they review. The moderate score of 3.48 indicates a level of satisfaction with the fairness and knowledgeability of regulatory committees, suggesting that our researchers perceive regulatory procedures as relatively conducive to maintaining a positive research environment. This interpretation aligns with previous studies in Egypt exploring the attitudes of researchers toward RECs, showing that more than 90% of participants held positive attitudes toward RECs (El-Dessouky et al., 2011; Kandeel et al., 2011) while only slightly more than 30% believed that RECs' deliberations would delay research.

We observed uniformity in the regulatory quality scores of Regulatory Quality across faculty members of all ranks in our study. This result aligns with studies performed in Amsterdam and the U.S.U.S. (T. L. Haven et al., 2019; Wells et al., 2014) but contrasts with a study from Hungary that showed graduate students scored higher on this subscale than faculty members (Armond & Kakuk, 2022). The higher scores for graduate students in the latter study might be due to younger academics being more accepting of authority, whereas faculty might have experienced prior challenges or frustrations with such committees. In Egyptian universities, institutional policies or cultural aspects might lead to a more uniform perception of regulatory quality across different academic ranks.

Our score of 3.48 for [Lack of] Integrity Inhibitors is lower than those reported in U.S.U.S. and Amsterdam universities (both above 3.8) (T. L. Haven et al., 2019; Martinson et al., 2013; Wells et al., 2014) which could imply a more pronounced adverse effect on Egyptian researchers due to limited research resources or heightened competitiveness. A recent qualitative study involving academics confirms the scarcity of research resources in universities from the Arab Middle East (Elgamri et al., 2023). The same study also revealed that instead of a teamwork approach to conducting research, there is competition among investigators and a failure to share ideas. Intense competition can compromise the integrity of scientific research, hinder the free exchange of information, and potentially result in harmful research practices (Anderson, Ronning, et al., 2007; Fanelli, 2010). Our findings also indicate a consistent perception across all academic ranks, aligning with studies from Hungary (Armond & Kakuk, 2022) and the U.S. (Wells et al., 2014), where junior and senior scientists reported similar experiences. This consistency implies that factors impeding research integrity do not discriminate by seniority.

The score for Integrity Norms was 3.24, which indicates that respondents perceive the presence of research integrity norms within their departments to be slightly above average. However, our score contrasts with studies performed in Hungary, Amsterdam, and the U.S.U.S., where scores clustered around 4.0 (Armond & Kakuk, 2022; T. L. Haven et al., 2019; Wells et al., 2014). Our lower observed score suggests that while there are established guidelines for research integrity, their practical influence may not be as significant as expected. This could be partly due to the recent implementation of Egypt's Clinical Trials Law (Matar & Silverman, 2022), which might need more time to change research practices substantially.

The Advisor/Advisee Relations subscale scored 3.24, indicating that mentorship is slightly above average. However, our score is lower than those observed involving researchers in Amsterdam, Hungary, and the U.S.U.S. (Armond & Kakuk, 2022; T. L. Haven et al., 2019; Wells et al., 2014) (all scores above 3.9). A recent qualitative study exploring challenges to conducting and publishing research revealed from graduate students studying in universities in the Arab Middle East that there was a shortage of experienced mentors (Elgamri et al., 2023). Lack of mentoring in Egyptian universities could be due to heavy faculty teaching loads, lack of incentives, the underappreciation of the mentoring role in academia, and poor salaries that prompt faculty to seek additional sources of income external to their universities, leading to insufficient time for mentoring. Furthermore, Egyptian higher education has not identified mentoring as an academic need. Consequently, programs focus on peer mentoring rather than formal faculty-student mentoring (Abdelrahman et al., 2020). Finally, there is no formal mentorship training in the health care organizations in Egypt (Hagrass et al., 2023), although one study in Egypt showed that an educational program involving mentorship competencies improved mentors' performance (Hagrass et al., 2023). It is concerning that mentoring has been overlooked, given that studies indicate mentorship can significantly enhance individuals' scholarly achievements and career progression (Dunlap, 2021). Moreover, some consider poor mentoring a major factor contributing to research misbehaviors (Bouter et al., 2016).

Other subscales with average scores less than 3.0 included Integrity Socialization (2.83) and RCR Resources (2.98). The below-average score associated with Integrity Socialization indicates that respondents believe some efforts are being made to socialize junior researchers into the norms of research integrity, but these efforts might not achieve their intended impact or might not be consistently successful not be more effective or are perceived as inconsistent. Several studies from the Arab Middle East have shown that junior investigators/graduate students have received less training in research ethics than upper-level faculty (El-Dessouky et al., 2011; Rababa'h et al., 2020). In the study from Egypt and Saudi Arabia, 26.1% of junior faculty received prior ethics training compared with 57.5% of mid-level faculty (El-Dessouky et al., 2011). Our score is lower than that observed in studies performed in universities in Hungary (Armond & Kakuk, 2022) and the U.S. (Wells et al., 2014) but similar to that observed in Amsterdam (T. L. Haven et al., 2019).

Finally, our scores for the Integrity Socialization subscale were similar across academic ranks. Other studies have found disparate results involving faculty. For example, Haven and colleagues (2019) found early- to mid-career scientists to score lower on Integrity

Socialization than associate and full professors, thus indicating that senior faculty acknowledge the importance of exposing junior staff to the norms of research integrity; however, according to the junior faculty, such training does not occur. Martinson et al. (2016) found the opposite effect in their study of researchers in the U.S., in which the senior staff perceived this scale to be lower than junior staff. In contrast, Wells et al. (2014) did not find notable differences by academic rank among U.S. academic researchers.

The moderate score for RCR resources (2.98) suggests that, despite availability, there are gaps in accessibility, promotion, and leadership support of RCR resources, hindering their effectiveness. Examples of such resources include educational activities, RCR policies/ guidelines, individuals with expertise in RCR, and the commitment of academic leaders to supporting RCR practices, including an office of research compliance. This score lags behind those from studies in the U.S., Hungary, and Amsterdam (Armond & Kakuk, 2022; T. L. Haven et al., 2019; Martinson et al., 2013, 2016; Wells et al., 2014). While Egypt has seen growth in research ethics infrastructure (Fogarty International Center, 2023; Marzouk et al., 2014) and new clinical trial regulations (Matar & Silverman, 2022), the true efficacy of RCR resources remains unfulfilled.

Our study revealed uniformity in RCR Resources subscale scores across all academic levels, indicating shared reservations about RCR Resources among both early-career and established researchers. This finding diverges from the studies by Haven et al. (2019) and Wells et al. (2014), where higher scores were observed among senior researchers compared to their junior counterparts.

Association of Demographics Variables with Subscale Scores

Our study revealed that faculty who mentored students or had a high publication output (mean scores of 3.55 and 3.35, respectively) received higher ratings on the Advisor/Advisee Relations subscale. This suggests that productive faculty members likely foster positive mentor-mentee relationships during research supervision. One might assume that such faculty are senior members, but the association between senior faculty and mentoring students was only marginally significant (p = 0.087).

In parallel, our study revealed no significant associations between academic rank and any of the other subscale scores, diverging from studies like Haven et al. (2019), which noted lower scores among early-career academics compared to senior faculty across four key subscales. Possible explanations for our findings include a uniform perception of the research integrity climate across ranks within Egyptian universities, perhaps due to a strong hierarchical culture that enforces uniform norms. A shared view of the research integrity climate might also be due to common challenges that might exist across ranks, such as funding, resource limitations, or access to RCR resources. Lastly, our sample size needed to be larger to capture academic rank-based differences.

Comparison with Academic Institutions in Other Countries.

Our study's subscale scores, hovering around a moderate 3.0, were consistently lower than those reported in the U.S.U.S. by Martinson et al. (2016) and Wells and colleagues (2014), as well as in studies from Hungary (2022) and Amsterdam (2019), where most of

the subscale scores were near or above 4.0. Moreover, except for the 'Lack of Integrity Inhibitors' subscale, our results were beneath the scores from top-tier research universities in the U.S.U.S. (Crain et al., 2013).

Academic researchers' lower perceptions of the research integrity climate in Egypt compared with those in countries with more advanced economies might be attributed to the lesser development of certain key elements within Egyptian universities. These elements encompass 'visible ethical leadership, socialization and communication processes, and the availability of policies, procedures, structures, and processes to address integrity risks. (IOM report, 2002; Martinson et al., 2013).

Concerning academic ethics leadership, the governance in higher education in Egypt is heavily centralized, with little room for institutional self-regulation, which restricts academic freedom within individual institutions (Karakus, 2020). Accordingly, public institutions enforce governmental policies (e.g., the Ministry of Higher Education, the Higher University Council, and the Higher Research Council) with little consultation with faculty or students. The hierarchical structure also accounts for academic leaders having less influence on their administrative affairs and departmental structures, although they have academic freedom regarding fundraising, teaching, and developing strategic research plans (Saliba, 2020). Finally, such a centralized structure might encourage "conformity and respect for authority" that inhibits "dissent and outspoken criticism" that might otherwise deter misconduct (Lee & Schrank, 2010).

Regarding "policies, procedures, structures," several commentators suggest that research misbehaviors may be more tolerated in LMICs than in HICs (Heitman & Litewka, 2011; Magnus et al., 2002), possibly due to the LMICs' underdevelopment of research integrity standards and regulatory frameworks compared to HICs. In support of this, Fanelli et al. (2015) found a higher frequency of retractions, indicative of research misconduct, from countries with nascent research integrity policies. Furthermore, a study examining attitudes toward plagiarism in Egyptian universities indicated that existing policies are insufficient in deterring such practices among researchers (Ali, 2021).

Moreover, a perceived sense of injustice could underlie the lower perception of the research integrity climate. The justice framework embedded in the SOuRCe tool suggests that perceived organizational injustices, primarily related to research integrity, might prompt individuals to engage in compensatory misbehaviors. Commentators argue (Martinson et al., 2010; T. L. Haven et al., 2019) that perceived unfairness in academic institutions can lead to misconduct, such as falsification, fabrication, plagiarism, and questionable research practices. This tendency is exacerbated in hierarchical education systems, which often lack self-regulation and mutual accountability and instead emphasize respect for authority (Lee & Schrank, 2010). Additionally, when a culture prioritizes outcomes like publications over ethical research processes, it may inadvertently encourage the violation of ethical and legal standards(Davis, 2003; Merton, 1938).

Finally, many universities in LMICs in the Arab Middle East involved with research activities are confronted with economic uncertainties (e.g., lack of governmental and

private funding), political and security uncertainties (e.g., the "Arab Spring" that caused unsafe institutional environments and migration of good faculty) that prevents them from functioning as "institutions of intellectual rigor and research" (Almansour, 2016). Not surprisingly, research represents a low priority among academic leaders as they are concerned with other issues vital to their survival (Almansour, 2016; Lages et al., 2015). Accordingly, international experts emphasize the importance of building a research infrastructure based on sustainable financial resources and a research system that motivates researchers.

Strengths & Limitations

We highlight several important strengths of our study. First, we adapted the SOuRCe tool for Egyptian researchers in academic institutions and provided the first data on the perception of research integrity in the Arab Middle East. Second, we showed that the SOuRCe tool could be adapted to investigate the perceptions of the institution's research integrity climate and that the performance of a study that used the SOuRCe tool is possible in the Arab region. Finally, compared with previous studies, we investigated several additional factors that can be associated with subscales of the research climate, specifically publication number, and involvement with mentoring efforts with graduate students.

Nevertheless, we acknowledge several study limitations. First, although we collected the precise number of responses we calculated under "sample size and technique," this sample size might have limited the study's power to detect statistically significant differences in subgroup analysis involving the demographic factors.

Secondly, although we showed that investigating the research integrity of institutions' research climates of institutions is "possible," challenges remain in recruiting institutions and affiliated staff. For example, evaluating the research integrity climate might be a sensitive topic in the Arab region, as academic leaders might be concerned that such a study could expose institutional shortcomings in structures, policies, and processes that support research integrity, potentially uncovering issues intertwined with broader socioeconomic and political contexts. This hesitancy might stem from the centralized governance and hierarchical nature of higher education in such countries, where there is a possible reluctance to scrutinize the research climate. Accordingly, we encountered challenges in gaining research approvals from two of the three universities that participated in this study, and a fourth university we tried to recruit did not agree to participate.

Another limitation involves sample bias as potential participants might have been reluctant to participate due to a concern that their identities regarding sensitive responses about their organizational research climates might be revealed, even though they were told the survey was anonymous. Armond and Kakuk (2022) described similar challenges in Hungary, where only 24% of invited doctoral schools agreed to participate in their study—this phenomenon of sample bias in our recruitment might limit the generalizability of our results.

A further limitation is that our targeted universities only included the "hard" science disciplines (i.e., biomedical, clinical, and dentistry), whereas other studies recruited universities that included a broader range of study fields, including the 'soft' sciences

such as humanities (Armond & Kakuk, 2022; T. L. Haven et al., 2019; Wells et al., 2014). However, targeting non-medical disciplines in Arab countries raises the issue of language as the researchers in these fields constitute predominantly non-English speaking populations, which would necessitate translation and validation of SOuRCe to the local language. Such an endeavor could be an area of future research.

Finally, our study's applicability to other university systems might be limited by unique sociocultural and political factors and differences in university governance. To mitigate this potential concern, we tailored the SOuRCe tool for the Egyptian context by conducting content validity assessments and cognitive interviews to ensure the relevance and clarity of each item. Furthermore, we maintain that the fundamental principles of research integrity are globally relevant, and hence, aspects of the research integrity climate should be independent of external factors. Nevertheless, we acknowledge the effects of sociocultural and political environments on the research climate. However, these influences might only sometimes be advantageous. Further qualitative studies would help explore the basis of participants' quantitative responses.

Nonetheless, we recognize that certain elements specific to the research integrity climate within Arab Middle Eastern universities might not have been fully captured. Consequently, we advocate for implementing qualitative research methods to identify any additional significant aspects.

Best Practices

The SOuRCe survey results indicated room for improvement in research integrity, with subscale scores ranging from 2.53 to 3.48. While scores above the midpoint of 3 suggest a moderate level of agreement with the aspects being measured by the items, it is not as high as it could be, suggesting areas suitable for targeted interventions to bolster the research integrity climate. We propose several practices and policies to augment all subscales.

Regarding Regulatory Quality, to improve regulatory committee effectiveness (e.g., RECs, drug regulatory authority, and compliance committees), institutions should ensure committee members are appropriately qualified and that compliance with regulations is manageable. Simplifying administrative procedures to support research, fostering transparency, and maintaining committee independence are crucial, particularly within hierarchical systems.

To enhance integrity socialization, institutions could implement comprehensive orientation for new researchers, mandatory training workshops on responsible research conduct, and regular forums for case discussion related to research integrity, providing a platform for open dialogue and learning.

Regarding opportunities for mentoring for junior scientists, Institutions should establish formal mentoring programs, provide professional development opportunities, evaluate mentor-mentee relationship health, and consider mentoring quality in performance evaluations to incentivize good practices.

Concerning RCR resources, with a score of 2.98 indicating neutrality, there is potential to improve RCR resources. Actions include clarifying and publicizing policies, enhancing

professional support, engaging leadership in RCR promotion, modeling responsible behavior in research, and recognizing and rewarding research integrity practices.

To further strengthen integrity norms in an academic setting, particularly with a score of 3.24 indicating a slightly above average presence of such norms, institutions should define and communicate research standards, incorporate integrity adherence in performance evaluations, ensure that departmental leaders visibly adhere to the norms thereby setting a powerful example, fostering a climate conducive to ethical discussions, rewarding integrity practices, and appointing a dedicated integrity officer.

To mitigate Integrity Inhibitors, institutions can promote collaboration over competition among colleagues by recognizing team achievements and facilitating joint projects, ensuring equitable resource distribution, balancing workloads to prevent unethical behavior, and establishing clear conflict of interest guidelines.

Addressing the lowest score of 2.53 observed for Departmental Expectations, academic leaders should set realistic publication and funding expectations, transparently communicate criteria for success, recognize diverse faculty contributions, including teaching excellence, community engagement, and other forms of scholarly activity, allocate time for research, and continuously review the research environment and expectations with the faculty.

Educational Implications:

We recommend several education initiatives to enhance the research integrity of climate factors investigated in this study. First, the RCR curriculum could be strengthened to make it more comprehensive and engaging. Academic leaders should also consider mandatory RCR training for all new researchers and refresher courses for existing staff. Topics should include research integrity, ethical decision-making, and the responsible conduct of research. Moreover, research integrity should be embedded into the curriculum, so students understand its importance from the outset of their careers. Furthermore, programs should be established that counsel faculty regarding their mentorship responsibilities. Finally, efforts should be instituted to enhance interprofessional collaborations.

Research Agenda:

Our study demonstrates that the SOuRCe tool is effective for evaluating research integrity climates across diverse faculties and departments within universities. Its successful application suggests that universities in other Low- and Middle-Income Countries (LMICs) in the Arab Middle East should consider similar assessments. Moreover, our findings provide a baseline for Egyptian academic institutions to benchmark and improve their research integrity climates using the SOuRCe tool, focusing on institutional rather than individual researcher behaviors.

We also propose the establishment of a SOuRCe score repository for participating institutions. This would enable the accumulation of a comprehensive data set, allowing academic leaders to compare their institutions' climates against a variety of profiles (Wells et al. 2014)

Despite the tool's successful adaptation from the U.S. to Egyptian contexts, some aspects of research integrity might still need to be explored. Hence, qualitative research is necessary to gain a deeper understanding of the research climates from the participants' viewpoints, complementing our quantitative data and providing a richer context.

Acknowledgement

Biographies

Elsayed Abdelkreem is from the Department of Pediatrics, Faculty of Medicine, Sohag University, Sohag, Egypt. He is a member of the research ethics committee at his university. He is a former trainee of the Fogarty-sponsored Middle East Research Training Initiative. He contributed to the design of the study, collected the data, and analyzed and interpreted the data.

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Table 1:

Respondents' Profile (n=228)

Demographic Variables	N	%
Gender		
Male	57	25.0
Female	171	75.0
Academic Rank		
Demonstrator/Master Student	53	23.2
Assistant Lecturer/Ph.D. Student	51	22.4
Lecturer	63	27.6
Assistant Professor	30	13.2
Professor	31	13.6
Supervising Students [1]		
Yes	116	59.79
No	78	40.21
Department Type		
Basic Medical Sciences	71	31.1
Clinical Medical Sciences	138	60.5
Dentistry	19	8.33
Number of Publications		
None	58	25.4
1-5	87	38.2
6-20	42	18.4
>20	41	18.0

[1] This question was optional

Table 2:

Descriptive Statistics: Mean Scores of the Subscales

	RCR Resources	Regulatory Quality	Integrity Norms	Integrity Socialization	Advisor/Advisee Relations	(Lack of) Integrity Inhibitors	Departmental Expectations
N	227	228	226	225	226	227	221
Items in Scale	6	3	4	4	3	6	2
Mean	2.98	3.48	3.24	2.83	3.24	3.48	2.53
SD	0.82	0.89	0.88	0.92	0.95	0.83	1.03
95% CI [lower, upper]	[2.87,3.09]	[3.36,3.59]	[3.13,3.36]	[2.72,2.96]	[3.11,3.36]	[3.37,3.59]	[2.39,2.67]
Cronbach's alpha [**]	0.849	0.814	0.861	0.890	0.885	0.842	0.720
95% CI [lower, upper]	[0.814,0.879]	[0.767,0.853]	[0.828,0.889]	[0.864,0.912]	[0.856,0.909]	[0.798,0.879]	[0.625,0.790]
skewness [*]	.118	−.143	.126	.211	−.220	−.439	.369
kurtosis [*]	−.539	−.609	−.663	−.309	−.499	−.318	−.497

[**] all p-values <0.05

[*] all SE<0.000

Table 3:

Association between Socio-demographics and participant's perception variables of Perceptions of Research Integrity Climate

	RCR Resources Mean (SD)	Regulatory Quality Mean (SD)	Integrity Norms Mean (SD)	Integrity Socialization Mean (SD)	Advisor/Advisee Relations Mean (SD)	Integrity Inhibitors Mean (SD)	Departmental Expectations Mean (SD)
Gender							
Male	2.97(0.96)	3.39(0.91)	3.14(0.87)	2.89(1.03)	3.17(0.96)	3.41(0.87)	2.67(1.16)
Female	2.99(0.77)	3.50(0.89)	3.28(0.88)	2.82(0.88)	3.26(0.95)	3.50(0.82)	2.48(0.99)
P-value *	.426	.596	.321	.640	.554	.461	.245
Highest Academic Degree							
Bachelor Degree	3.17(0.81)	3.52(0.89)	3.38(0.80)	3.10(0.94)	3.38(1.02)	3.61(0.81)	2.67(1.04)
Master's Degree	3.04(0.86)	3.52(0.95)	3.23(0.90)	2.82(0.97)	3.13(1.02)	3.38(0.92)	2.65(1.05)
MD/PhD	2.90(0.81)	3.44(0.87)	3.22(0.89)	2.77(0.88)	3.26(0.90)	3.50(0.78)	2.43(1.02)
P-value *	.073	.570	.423	.101	.820	.871	.132
Academic Rank							
Demonstrator/Master' s Student	3.19(0.88)	3.58(0.91)	3.40(0.89)	3.07(0.99)	3.37(1.03)	3.43(0.92)	2.87(1.08)
Assistant lecturer/PhD	2.92(0.78)	3.42(0.93)	3.08(0.85)	2.66(0.93)	3.00(1.01)	3.44(0.88)	2.34(0.96)
Lecturer	2.70(0.80)	3.27(0.83)	3.10(0.89)	2.62(0.87)	3.02(0.87)	3.56(0.77)	2.27(0.97)
Assistant Professor	2.89(0.71)	3.48(0.90)	3.19(0.84)	2.85(0.80)	3.38(0.82)	3.42(0.76)	2.5(0.80)
Professor	3.37(0.76)	3.81(0.86)	3.60(0.81)	3.16(0.80)	3.71(0.78)	3.50(0.79)	2.83(1.21)
P-value *	.858	.504	.468	.774	.087	.713	.694
Supervising Students							
Yes	2.99(0.85)	3.56(0.88)	3.27(0.89)	2.88(0.89)	3.35(0.90)	3.43(0.84)	2.55(1.05)
No	2.92(0.76)	3.29(0.81)	3.16(0.81)	2.71(0.90)	3.02(0.91)	3.63(0.75)	2.49(0.91)
P-value *	.598	**.031**	.383	.187	**.014**	.095	.659
Department Type							
Basic Medical Sciences	2.96(0.85)	3.50(0.90)	3.28(0.91)	2.89(0.94)	3.27(0.99)	3.44(0.83)	2.48(1.08)
Clinical Medical	2.96(0.83)	3.43(0.90)	3.19(0.86)	2.77(0.92)	3.20(0.96)	3.47(0.84)	2.51(1.01)
Sciences Dentistry	3.13(0.72)	3.71(0.87)	3.50(0.87)	3.14(0.78)	3.40(0.82)	3.67(0.79)	2.87(0.98)
P-value *	.591	.694	.746	.769	.932	.387	.267
Number of Publications							

	RCR Resources Mean (SD)	Regulatory Quality Mean (SD)	Integrity Norms Mean (SD)	Integrity Socialization Mean (SD)	Advisor/Advisee Relations Mean (SD)	Integrity Inhibitors Mean (SD)	Departmental Expectations Mean (SD)
None	3.03(0.85)	3.43(0.91)	3.21(0.89)	2.85(1.02)	3.10(1.06)	3.48(0.95)	2.53(1.07)
1-5	2.88(0.82)	3.42(0.89)	3.16(0.79)	2.75(0.88)	3.15(0.92)	3.52(0.74)	2.44(1.01)
6-20	2.88(0.83)	3.44(0.88)	3.34(0.99)	2.80(0.87)	3.30(0.89)	3.46(0.85)	2.50(0.88)
>20	3.21(0.78)	3.71(0.90)	3.38(0.93)	3.05(0.89)	3.55(0.88)	3.40(0.84)	2.77(1.19)
P-value*	.374	.146	.227	.286	**.014**	.571	.270

*P-value significant at <0.05

Additional file 1

Modifications to the Survey of Organizational Research Climate (SOuRCe) tool

Subscale	Modified Survey	Original Survey[*]
Part 1: Institutional items		
	1. How committed are researchers at your university to maintaining high standards of integrity in their research?	1a. How committed are researchers at your university to maintaining high standards of integrity in their research?
	2. How consistently does the organizational climate at your university consider the importance of "responsible conduct of research"?	1b. How consistently does the overall "climate" at your university reflect high values for responsible conduct of research?
Institutional Regulatory Quality	3. How respectful to researchers are research ethics committees that review the type of research you do? (e.g., they provide proper justifications for requested changes in your protocols, review protocols in a timely fashion)	1c. How respectful to researchers are the regulatory committees or boards that review the type of research you do (e.g., IRB, IACUC)?
Institutional RCR Resources	4. How effectively do the available educational activities at your university teach about responsible research practices (e.g., lectures, seminars, web-based courses)?	1d. How effectively do the available educational opportunities at your university teach about responsible research practices (e.g., lectures, seminars, web-based courses)?
Institutional Regulatory Quality	5. How well do the research ethics committees that review your research understand the kind of research you do?	1e. How well do the regulatory committees or boards that review your research (e.g., IRB, IACUC) understand the kind of research you do?
Institutional RCR Resources	6. How accessible (e.g., can be reached by email, phone call, or appointment) are individuals with appropriate expertise (e.g., in your university) that you could ask for advice if you had a question about research ethics?	1f. How accessible are individuals with appropriate expertise that you could ask for advice if you had a question about research ethics?
Institutional RCR Resources	7. How accessible (e.g., university website) are your university's policies/guidelines that relate to responsible research practice?	1g. How accessible are your university's policies/guidelines that relate to responsible research practices?
Institutional RCR Resources	8. How committed are the academic leaders at your university to supporting responsible conduct in research?	1h. How committed are the senior administrators at your university (e.g., deans, chancellors, vice presidents) to supporting responsible research?
Institutional RCR Resources	9. How effectively do the academic leaders at your university communicate high expectations for research integrity? (e.g. via emails, reports, announcements, meetings, speeches)	1i. How effectively do the senior administrators at your university (e.g., deans, chancellors, vice presidents) communicate high expectations for research integrity?
Institutional Regulatory Quality	10. How fair to researchers are the research ethics committees that review the type of research you do?	1j. How fair to researchers are the regulatory committees or boards that review the type of research you do (e.g., IRB, IACUC)?
Institutional RCR Resources	11. How confident are you that if you needed to report a case of suspected research misconduct, you would know who to contact to make a report?	1k. How confident are you that if you needed to report a case of suspected research misconduct, you would know where to turn to determine what procedures to follow?
Part 2: Department/program items		
	1. How committed are people (staff members, postgraduate students) in your department/program to maintaining high standards of integrity in their research?	2a. How committed are people in your department to maintaining high standards of integrity in their research?
	2. How consistently does the overall "climate" in your department/program (e.g., the work environment) reflect high values for the responsible conduct of research?	2b. How consistently does the overall "climate" in your department reflect high values for the responsible conduct of research?
Subunit Expectations	3. How fair are your department/program's expectations of researchers for obtaining external funding (e.g., is your department reasonable in their expectations that you will receive external funding)?	2c. How fair are your department's expectations of researchers for obtaining external funding?
Subunit Integrity Inhibitors	4. How difficult is it to conduct research in a responsible manner because of insufficient access to human resources such as statistical expertise, administrative or technical staff?	2d. How difficult is it to conduct research in a responsible manner because of insufficient access to human resources such as statistical expertise, administrative or technical staff?

Subscale	Modified Survey	Original Survey[*]
Subunit Expectations	5. How fair are your department/program's expectations concerning publishing (e.g., is your department reasonable in their expectations of number of articles you should be publishing on a yearly basis; considering the available research fund/support)?	2e. How fair are your department's expectations with respect to publishing?
Subunit Integrity Inhibitors	6. How protective (cautious) are people (staff members, postgraduate students) in their communications with each other out of concern that someone else will "steal" their ideas?	2f. How guarded are people in their communications with each other out of concern that someone else will "steal" their ideas.
Subunit Integrity Norms	7. How consistently do people (staff members, postgraduate students) in your department/program obtain permission (verbal or written approval) or give due credit (e.g., citation, acknowledgment) when using another's words or ideas?	2g. How consistently do people in your department obtain permission or give due credit when using another's words or ideas?
Subunit Integrity Socialization	8. How committed are staff members in your department/program to discussing with their postgraduate students about fundamental principles of research integrity?	2h. How committed are advisors in your department to talking with advisees about key principles of research integrity?
Subunit Integrity Inhibitors	9. How difficult is it to conduct research in a responsible manner because of insufficient access to material resources such as space, equipment, or technology?	2i. How difficult is it to conduct research in a responsible manner because of insufficient access to material resources such as space, equipment, or technology?
Subunit Integrity Socialization	10. How effective is the working climate in your department in cultivating appropriate attitudes about responsible research practices among junior researchers?	2j. How effectively are junior researchers socialized about responsible research practices?
Subunit Integrity Socialization	11. How consistently do staff members in your department/program (e.g., chairs, program heads) communicate (e.g., emails, reports, announcements, meetings, speeches) high expectations for research integrity?	2k. How consistently do administrators in your department (e.g., chairs, program heads) communicate high expectations for research integrity?
Subunit Integrity Inhibitors	12. How true is it that pressure to publish has a negative effect on the integrity of research in your department/program?	2l. How true is it that pressure to publish has a negative effect on the integrity of research in your department?
Subunit Integrity Socialization	13. How consistently do staff members communicate to their postgraduate students well-defined performance expectations related to their academic achievement or progress?	2m. How consistently do advisors/supervisors communicate to their advisees/supervisees clear performance expectations related to intellectual credit?
Subunit Advisor / Advisee Relations	14. How fairly do staff members treat postgraduate students?	2n. How fairly do advisors/supervisors treat advisees/supervisees?
Subunit Integrity Norms	15. How consistently do research practices in your department/program follow established institutional policies?	2o. How consistently do research practices in your department follow established institutional policies?
Subunit Integrity Norms	16. How important is honesty in proposing, performing, and reporting research in your department/program?	2p. How valued is honesty in proposing, performing, and reporting research in your department?
Subunit Advisor / Advisee Relations	17. How respectfully do staff members treat postgraduate students?	2q. How respectfully do advisors/supervisors treat advisees/supervisees?
Subunit Integrity Inhibitors	18. How true is it that pressure to obtain external funding has a negative effect on the integrity of research in your department/program?	2r. How true is it that pressure to obtain external funding has a negative effect on the integrity of research in your department?
Subunit Integrity Norms	19. How committed are people (staff members, postgraduate students) in your department/program to maintaining data integrity (completeness, accuracy, and consistency) and data confidentiality (secrecy)?	2s. How committed are people in your department to maintaining data integrity and data confidentiality?
Subunit Integrity Inhibitors	20. How true is it that people (staff members, postgraduate students) in your department/program are more competitive with one another than they are cooperative regarding research?	2t. How true is it that people in your department are more competitive with one another than they are cooperative?
Subunit Advisor / Advisee Relations	21. How available are staff members to their postgraduate students for help with their research?	2u. How available are advisors/supervisors to their advisees/supervisees?
	Open-ended question	
	Are there any other things about your organizational climate that you would like to tell and about which we have not already asked?	Are there any other things about your organizational climate that you would like to tell and about which we have not already asked?

[*]Thrush CR, Martinson BC, Crain AL, Wells JA. User's Manual for the Survey of Organizational Research Climate (SOuRCe), version 2. 2014.