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BIOKEMIJSKA OSNOVA LIČNOSTI

SAŽETAK

Cilj dvaju istraživanja bio je da se odrede relacije između nekih psihometrijski utvrđenih karakteristika ličnosti i odabranih biokemijskih spojeva prije i poslije programa fizičke kondicije. Primjećeno je da su u oba ispitivanja ispitanici doživjeli korsne fiziološke promjene, jer se u testu poslije programa vidjelo da im je bolji rad srca i krvnih sudova, što se odrazilo na značajnim rezultatima povezanima s bodovima za fizičku kondiciju.

Rezultati faktorske analize, kao i rezultati kanoničke korelacijske analize potvrdili su da su odabrani biokemijski spojevi uistinu povezani s karakteristikama ličnosti.

Unatoč izrazitom poboljšanju kondicije ispitanika relacije između biokemijskih i varijabli ličnosti nisu se znatno izmijenile u toku četveromjesečnog perioda vježbanja. Budući da je organizam uvijek u dinamičkom stanju homeostaze, neznatno izmijenjene relacije između ta dva područja vjerojatno odražavaju takav mehanizam. Logično se pretpostavlja da je nužan mnogo dulji i intenzivniji period redovitog opterećenja da se postignu značajne promjene parametara ličnosti. Takva promjena bila bi rezultat značajne izmjene tjelesnog kemizma, jer su fiziološko područje, biokemijsko područje i područje ličnosti u neraskidivoj međusobnoj vezi.

UVOD

U članku objelodanjenom u časopisu »Science« koji govori o novijim dostignućima na području neurobiologije, Kolata je istaknula koliko je teško proučavati karakteristike ličnosti ljudskih bića zbog nedovoljne preciznosti tehnikâ mjerenja (Kolata, 1979). Izrazila je, međutim, nadu da će istraživači uspjeti u budućnosti povezati neurobiološke nalaze koji se odnose na životinje i one koji se odnose na ljude, pretpostavljajući da se neki osnovni principi mogu primijeniti općenito. Ovaj je napis tek skroman doprinos tom cilju. Proučavanjem prirode ljudske ličnosti sa stanovišta biokemije i sa stanovišta psihometrije, nadamo se da će se naći zajednička veza između ta dva pristupa.

Poznata je činjenica da je istinsko ponašanje, otvoreno ili prikriveno, po prirodi biokemijsko. Oduvijek se smatra da je određivanje karakteristikâ ličnosti primjenom psihometrijskih tehnika neadekvatno zato što nije dovoljno precizno. Stoga se nadamo, primjenom odabranih biokemijskih korelata ličnosti pri utvrđivanju karakteristika ličnosti, doći do važnih podataka u pogledu točnosti mjerenja karakteristika ličnosti, a možda će se donekle objasniti i biokemijska priroda takvih karakteristika.

Istraživanjima na području životinjske i ljudske endokrinologije dokazano je da postoji povezanost između razine nekih spojeva u serumu i specifičnih obrazaca ponašanja.

Spojevi koji se najčešće dovode u vezu s emocionalnim stanjem su kortikosteroidi (Mason i suradnici, 1968), kateholamini (Mason, 1968), glukoza (Heaman i suradnici, 1970; Koch i Molnar, 1974; Young i Ismail, 1975), kolesterol (Jenkins i suradnici, 1969; Rahe i suradnici, 1971; Sloane i suradnici, 1961; Young i Ismail, 1975) i, u novije vrijeme, androgeni (Rose, 1972).

Pokazalo se da su karakteristike ličnosti kao što su kompetitivnost i agresija (Sletten i suradnici, 1964), ekstraverzija (Sloane i suradnici, 1961) i osjećaji depresije i straha (Rahe i suradnici, 1971) povezani s povišenom razinom kolesterola. Emocionalna stanja koja se dovode u vezu s visokim razinama kolesterola mogu imati kardiodinamičke efekte najvjerojatnije preko kateholamina (Sloane i suradnici, 1961). Zamijećeno je da se kateholamini oslobađaju u raznovrsnim stanjima stresa (Euler, 1974; Konzett i suradnici, 1971; Rao i Bhatt, 1972) i da odražavaju intenzitet emocionalnih reakcija (Frankenhaeuser, 1970; Schildkraut, 1965). Povećane koncentracije kateholamina u optoku nađene su u bolesnika s esencijalnom hipertenzijom (Azelrod i Weinshilboum, 1972; Engelman i suradnici, 1970; Wartman i suradnici, 1970) te u urinu (Ghose i suradnici, 1972) i plazmi (Videbaek i suradnici, 1972) bolesnika koji se oporavljaju od infarkta miokarda.

Iako seksualni hormoni prvenstveno utječu na seksualno ponašanje, ustanovljeno je da testosteron ima jasnu ulogu kad je posrijedi agresija (Lee i Griffo, 1973; Payne i Swanson, 1972; Persky i suradnici, 1971) i društveno ponašanje (Rose i suradnici, 1972). Pokazalo se da razne stresne situacije, i u životinja, i u ljudi, uzrokuju smanjeno izlučivanje testosterona. Ovdje su uključeni: kirurški stres (Carstensen i suradnici, 1972); klima (Briggs 1972);

izbjegavanje šoka (Mason i suradnici, 1968) i psihološki stres (Kreuz i suradnici, 1972). U posljednje je vrijeme također utvrđeno da je povišen testosteron u muškaraca povezan s češćom pojavom koronarnih bolesti srca (Morse i suradnici, 1968).

Novija istraživanja u vezi s fiziološkim, biokemijskim i psihološkim statusom »normalnog« sredovječnog muškarca ukazala su na to da postoje jasne razlike u ličnosti između treniranih i netreniranih pojedinaca. Podaci su, nadalje, upućivali na zaključak da sudjelovanje u četveromjesečnom programu za stjecanje kondicije utječe ne samo na fiziološke parametre već i na karakteristike ličnosti, posebice one karakteristike koje se odnose na emocionalnu stabilnost (Ismail i Trachtman, 1973; Ismail i Young, 1973; Ismail i Young, 1975; Young i Ismail, 1975). Svrha je ovog rada, dakle, da se ispitaju, na multivarijatni način, relacije između izabranih biokemijskih spojeva i karakteristika ličnosti prije i poslije dugoročnog programa tjelesnog vježbanja, a specijalna je svrha ispitivanja bila da se odredi utjecaj programa tjelesnog vježbanja na identificirane relacije.

POSTUPCI

Dva ispitivanja provedena su jedno za drugim da se odrede veze između karakteristikâ ličnosti i izabranih biokemijskih spojeva. Prvo ispitivanje sastojalo se u tome da se istraži postoje li ili ne postoje zapravo takve veze. Zato je odlučeno da se provede faktorska analiza odabranih antropometrijskih, fizioloških, biokemijskih i varijabli ličnosti, kako bi se ispitala priroda faktorske strukture koja uključuje te varijable. Nakon što je ispitana dobivena faktorska struktura, donesena je odluka da se nastavi drugim istraživanjem. Budući da je faktorska struktura pokazala da su varijable ličnosti saturirane istim faktorima kao i biokemijski spojevi, odlučeno je da se u drugom ispitivanju prouči u kojoj su mjeri karakteristike ličnosti i biokemijski spojevi povezani. Nadalje, prikupljeni su podaci do kojih se došlo prije i poslije provođenja programa fizičke kondicije, da bi se proučio utjecaj dugotrajnog tjelesnog vježbanja na identificirane veze.

Podaci su prikupljeni i analizirani primjenom multivarijatnih statističkih postupaka. Specijalno su poslužile faktorska analiza, kanonička korelacija i diskriminativna analiza.

ISPITANICI

Ispitanici za oba ispitivanja bili su nastavno i ostalo osoblje sa sveučilišta Purdue te lokalni poslovni ljudi između 21 i 61 godine, koji su se dobrovoljno prijavili da će sudjelovati u 4-mjesečnom programu fizičke kondicije.

VARIJABLE

Za prvo istraživanje prikupljeni su podaci u odnosu na područje antropometrije, i to o kronološkoj dobi (dob) i postotku mišične mase bez masti (postotak mišićne mase). Postotak mišićne mase određen je primjenom metode Wilmorea i Behnkea (1969).

Fiziološke varijable sastojale su se od sistoličkog (sist) i dijastoličkog (diast) krvnog tlaka, određenih na uobičajeni način; submaksimalne brzine rada srca (SHR), izračunate na kraju 10-minutnog hodanja na pokretnom ćilimu; i fizičke kondicije, određene po kriterijima Ismaila i suradnika (1965).

Biokemijske varijable bile su kolesterol u serumu, određen Hycel metodom stalnog određivanja reagensima za kolesterol, Hycel, Houston, Texas, i glukoza u serumu određena metodom Harleco, Harleco, Inc., Philadelphia, Pennsylvania.

EPI (Eysenck Personality Inventory), 1963, poslužio je da se dobiju podaci o ličnosti u toku prvih i posljednjih sedmica programa. Na početku je upotrijebljena forma A, a na kraju forma B.

Prilikom drugog istraživanja prikupljeni su podaci do kojih se došlo prije i poslije provođenja programa sa četiri biokemijske varijable, odabrane zato što je ranije pokazano da su povezane s nekim karakteristikama ličnosti (Heaman i suradnici, 1970; Jenkins i suradnici, 1969; Mason i suradnici, 1968; Rahe i suradnici, 1971; Sloane i suradnici, 1961; Young i Ismail, 1975).

1. Glukoza u serumu — određena metodom Hultmana (1959), modifikacija Dubowskog (1962) reagensima dobivenim od firme Hycel, Inc., Houston, Texas.
2. Kolesterol u serumu — određen direktnom metodom za serum, Hycel, Hycel, Inc., Houston, Texas.
3. Testosteron u serumu — određen adaptacijom tehnike radioimunoanalize što su je opisali Chen i suradnici (1971) primjenom reagensâ firme Wien Laboratories, Inc., Succasunna, New Jersey.
4. Slobodni kateholamini (epinefrin i norepinefrin) — određeni u 24-satnom uzorku urina primjenom kolonâ smola-izmjenjivača ionâ iz Bio-Rad Laboratories, Richmond, California.

Osim toga, upotrijebljene su ove varijable ličnosti:

1. 16 PF (Cattell 16 PF Questionnaire) — Forma A (1970)
2. EPI (Eysenck Personality Inventory) — Forma A (1963)

REZULTATI

Prosjeci i standardne greške varijabli za prvo istraživanje prije i poslije programa dati su u tabeli 1.

Četiri faktora ekstrahirana su iz podataka prije i poslije programa i oni objašnjavaju 70.54, odnosno 69.48 posto ukupne varijance. Svi rezultati predočeni su u tabelama 2 i 3.

Karakteristika prvog faktora su saturacije submaksimalne brzine rada srca, fizičke kondicije i neurotičnosti prije i poslije provođenja programa. Na početku je izgledalo da je neurotičnost značajna varijabla, no značenje joj je nešto manje u konačnim rezultatima, kad ustupa mjesto dobi i postotku mišićne mase. Prema ovom ispitivanju izgledalo bi da su oni pojedinci koji su u vrlo dobroj kondiciji — stariji i predstavljaju redovito aktivnu grupu. Ovaj je faktor dobio ime: *fizička kondicija i emocionalna stabilnost.*

Faktor dva ima velike saturacije prvenstveno povezane sa sistoličkim i dijastoličkim krvnim tlakom. On ilustrira povezanost između krvnog tlaka i fizičke kondicije i, u izvjesnoj mjeri, emocionalne stabilnosti. Ponovo se vidi koliko je u faktorskoj strukturi poslije programa važna dob. Faktor se naziva: *odnos između krvnog tlaka i fizičke kondicije.*

Faktor tri ima velike saturacije u pogledu kolesterola u serumu, na početku kao i na kraju. Na početku programa velike količine kolesterola bile su povezane s gojaznošću i ekstremnom ekstraverzijom koja karakterizira tipičnog endomorfa. Na kraju programa nije visoki nivo kolesterola zavisio o dimenzijama ličnosti, već je povišeni kolesterol bio u vezi s raspoložívom energijom kao što je glukoza. Faktor se definira kao: *gojaznost i ekstraverzija.*

Na početku je faktor četiri bio tipičan za mladolikost, mršavost i hipoglikemiju, dok se na kraju pojavila nova faktorska struktura koja je karakteristična za neurotičnog introverta.

Koeficijenti diskriminacije za grupu dobre naspram grupe vrlo niske fizičke kondicije na početku i na kraju dati su u tabeli 4, odnosno 5.

Rezultati prije provođenja programa pokazuju utjecaj odabranih varijabli na razlike između grupa dobre i vrlo niske fizičke kondicije. Prema koeficijentima se vidi da neurotičnost i postotak mišićne mase, tim redom, pokazuju značajne razlike između grupe dobre i grupe vrlo niske fizičke kondicije, s time da grupa dobre kondicije ispoljava veću emocionalnu stabilnost i veći postotak mišićne mase. Rezultati poslije programa pokazuju da su za svaku grupu dobijene nulte pogreške klasifikacije. U tom je slučaju ustanovljeno da su postotak mišićne mase i introverzija, tim redom, najbolji diskriminatori, na osnovi čega se pretpostavlja da je smanjeno značenje dimenzije neuroza-stabilnost i naglašena važna varijabla kondicije, tj. postotak mišićne mase.

Prosjeci i standardne greške prije i poslije provođenja programa biokemijskih i varijabli ličnosti za drugo ispitivanje dati su u tabeli 6.

Kanoničke korelacije, postotak ukupne moguće varijance i ponderi povezani sa svakom korelacijom između biokemijskog (p) i skupa varijabli ličnosti (q) date su u tabeli 7. Relacije između skupova p i q za podatke prije programa bile su značajne na razini 01, uz upotrebu kriterija najvećeg korijena i kriterija zbroja korijena.

Relativne vrijednosti povezane s prvom kanoničkom korelacijom ukazale su na to da je prevaga varijance između biokemijskog skupa i skupa varijabli ličnosti rezultat vezâ između testosterona i glukoze i varijabli ličnosti: neurotičnosti, E (submisivno naspram agresivno) i C (emocionalna nestabilnost naspram emocionalna stabilnost). Proučavanje univarijatne korelacione matrice da bi se utvrdio smjer odnosâ, pokazalo je da obrazac u ovoj korelaciji indicira kako ljudi s velikom koncentracijom testosterona i glukoze u serumu imaju tendenciju da budu neurotični i agresivni.

Druga kanonička korelacija ukazala je na to da je do pretežnog dijela varijance zajedničke za oba skupa došlo zbog relacija između glukoze i kolesterola i G (koristoljubivo naspram savjesno), Q_4 (sabrano naspram napeto), te konformnosti i neurotičnosti iz EPI. U ovom slučaju obrazac ukazuje na to da su velike količine glukoze i kolesterola u serumu povezane s malom snagom superega, napetošću, nekonformnošću i emocionalnom nestabilnošću. Prema podacima izgleda da su pojedinci s hiperglikemijom i hiperkolesterolemijom nestalni, lakoumni, da ne poštuju propise, da su nepouzdani, te da se ne trude da učine najbolje što mogu.

Treća kanonička korelacija nalik je drugoj, a ponderi su pokazali da je veći dio varijance između dva skupa posljedica relacijâ između kolesterola i glukoze u serumu te mjere konformnosti iz EPI, C (emocionalna nestabilnost naspram emocionalna stabilnost) i Q_4 (sabrano naspram napeto). Prema tom se obrascu vidi da su hiperkolesterolemija i hiperglikemija povezane s nekonformnošću, emocionalnom nestabilnošću i napetošću. Zato su vjerojatno pojedinci s visokim kolesterolom i glukozom emocionalno nestabilni i nekonformistički. Ova kanonička korelacija razlikuje se od druge u pogledu snage superega.

Četvrta kanonička korelacija pokazuje da je najveći dio varijance između dva skupa proistekao iz relacija između lučenja kateholamina urinom i Q_4 (sabrano naspram napeto), neurotičnosti i G (koristoljubivo naspram savjesno). Ova je korelacija ukazala na to da je velika količina izlučenog kateholamina povezana s neurotičnošću i napetošću.

Korelacije između skupa biokemijskih (p) i skupa varijabli ličnosti (q) za podatke nakon provođenja programa sadrži tabela 8. Utvrđeno je da su re-

lacije između ta dva skupa značajne na razini. 0,1 uz primjenu kriterija najvećeg korijena i kriterija zbroja korijena.

Kanoničke korelacije ustanovljene testiranjem poslije programa neznatno su se razlikovale od onih prije programa. Na početku je glukoza bila spoj što su ga najčešće sadržavale sve četiri kanoničke korelacije. U toku završnog perioda testiranja, u tom pogledu glukozu je nadomjestilo izlučivanje kateholamina.

U prvoj kanoničkoj korelaciji relativni ponderi ukazivali su na to da je za najveći dio varijance između biokemijskog i skupa ličnosti odgovorna relacija između lučenja kateholamina urinom i koncentracije testosterona u serumu i varijabli ličnosti: O (sigurno naspram nesigurno); neurotičnost, i M (konvencionalno naspram bohemsko). U tom je slučaju velika količina izlučenog kateholamina, kad je u kombinaciji s velikom količinom testosterona u serumu, povezana s neurotskom agresijom i nekonvencionalnošću. I kanoničke korelacije prije, kao i poslije provođenja programa ilustriraju povezanost između lučenja kateholamina i onih karakteristika ličnosti koje su tipične za neurotičnost.

Druga kanonička korelacija ilustrirala je veze između koncentracije kolesterola u serumu i lučenja kateholamina i G (koristoljubivo naspram savjesno), M (konvencionalno naspram bohemsko) i ekstraverzije iz EPI. Prema primijećenom obrascu u toj korelaciji čini se da su hiperkolesterolemija i velika količina izlučenog kateholamina povezane sa snagom susuperega, s nekonvencionalnošću i ekstraverzijom.

Treća kanonička korelacija otkrila je da postoje veze između testosterona u serumu i lučenja kateholamina i neurotičnosti O (sigurno naspram nesigurno) i skale laži iz EPI. Ova korelacija potvrđuje univarijatnu korelacionu matricu i faktorsku strukturu gdje su velike količine testosterona i glukoze povezane s neurotičnošću i agresijom. Isti obrazac primijećen je na kraju, osim što je došlo do pomaka prema lučenju kateholamina u odnosu na glukozu.

Četvrta kanonička korelacija upućuje na zaključak da najveći dio varijance između dva skupa rezultata iz relacija između koncentracije glukoze u serumu i C (emocionalna nestabilnost naspram emocionalna stabilnost) i ekstraverzije. U tom je slučaju hipoglikemija povezana s emocionalnom stabilnošću i ekstraverzijom.

DISKUSIJA

Cilj ovih dvaju istraživanja bio je da se odrede relacije između nekih psihometrijski ustaovljenih karakteristika ličnosti i odabranih biokemijskh spojeva prije i poslije programa za fizičku kondiciju. Primijećeno je da su u oba ispitivanja ispitanici doživjeli korisne fiziološke promjene, jer se u testu poslije programa vidjelo da im je bolji rad srca i krvnih sudova, što se odrazilo na značajnim rezultatima s obzirom na bodove za fizičku kondiciju.

Rezultati faktorske analize, kao i rezultati kanoničke korelacije potvrdili su da su odabrani biokemijski spojevi uistinu povezani s karakteristikama ličnosti, a to je u skladu s tvrdnjom Eysencka (Eysenck, 1964). Usporedba početnih s konačnim rezultatima pokazuje da je u tim relacijama došlo do neznatnih promjena — vjerojatno kao rezultat programa opterećenja. Na početku su pojedinci s visokim koncentracijama testosterona i glukoze u serumu, promatrani u toku drugog ispitivanja, ispoljavali sklonost neurotičnosti i agresivnosti. Agresija se dovodi u vezu s lučenjem testosterona (Lee i Griffo, 1973; Payne i Swanson, 1972; Persky i suradnici, 1971), a glukoza s neurotičnošću (Stanaway i Hullin, 1973; Young i Ismail, 1975). Stanamay i Hullin (1973) pretpostavili su da je veza između glukoze i neurotičnosti, primijećena u oba ispitivanja, možda uvjetovana djelovanjem epinefrina i simpatikusa, koji stimuliraju oslobađanje glukoze iz glikogena u jetri.

Ustanovljeno je da su hiperkolesterolemija i hiperglikemija, prilikom testiranja prije programa, u korelaciji s lakomislenošću i malom snagom superega, osobito u drugom ispitivanju. Nasuprot tome, pri testiranju poslije programa, hiperkolesterolemija je dovedena u vezu s lučenjem kateholamina. Lipidi u serumu očito su vezani s nekim karakteristikama ličnosti (Rahe i suradnici, 1971; Sletten i suradnici, 1964; Sloane i suradnici, 1961; Young i Ismail, 1975). U prvom ispitivanju ustanovljeno je, osim toga, da je hiperkolesterolemija povezana s ekstraverzijom i gojaznošću na početku programa fizičke kondicije, ali ne i na kraju. U drugom ispitivanju bili su kolesterol i glukoza u serumu povezani s emocionalnom stabilnošću i konformnošću na početku, no na kraju programa činilo se da je kolesterol povezan s testosteronom i pomanjkanjem fizičke kondicije. Iako se kolesterol nije značajno smanjio od testa prije do testa poslije programa, njegova relacija prema drugim mjerama izmijenila se po svoj prilici kao posljedica programa sticanja kondicije.

U drugom ispitivanju utvrđeno je da je količina izlučenog kateholamina urinom povezana s neurotičnošću — to osobito vrijedi za testiranje provedeno poslije programa. Taj nalaz potvrđuje kateholaminsku hipotezu o afektivnim poremećajima što ju je postavio Schildkraut (1965), a uvelike se temelji na proučavanju urinarnih metabolita kateholamina. Hipoteza implicira da su neke, ako ne i sve, depresije povezane s pomanjkanjem kateholamina, posebice norepinefrina, na funkcionalno važnim mjestima adrenergičnih receptora u mozgu.

Unatoč izrazitom poboljšanju fizičke kondicije ispitanika relacije između biokemijskih i varijabli ličnosti nisu se znatno izmijenile u toku 4-mjesečnog perioda. Budući da je organizam uvijek u dinamičkom stanju homeostaze, neznatno izmijenjene relacije između ta dva područja što je primijećeno prili-

kom testiranja poslije programa u drugom istraživanju) vjerojatno odražavaju takav mehanizam. Logično se pretpostavlja da je nužan mnogo dulji i intenziviran period redovitog (uobičajenog) opterećenja da se postignu značajne promjene parametara ličnosti; u prilog tome govori značajna razlika između grupe dobre i grupe vrlo niske fizičke kondicije u prvom ispitivanju. Takva promjena bila bi rezultat značajne izmjene tjelesnog kemizma, jer su fiziološko područje, biokemijsko područje i područje ličnosti u neraskidivoj međusobnoj vezi.

Naše buduće istraživanje bit će posvećeno neurobiokemijskim spojevima koji su osnova ličnosti i njihovim relacijama s dugotrajnim vježbanjem. Ranije istraživanje ukazuje na to da neki endogeni opiodi (β — endorfini i enkefalini) vjerojatno funkcioniraju kao neuromodulatori i hormoni što utječu na živčana područja odgovorna za percepciju »boli«, transmiter, disanje, motornu integraciju, endokrine reakcije, i limbički sistem koji ima veze sa stvaranjem emocionalnih stanja. Iz bihejvioristićkih ispitivanja moglo bi se zaključiti da stres povećava koncentraciju endorfina u krvi i mozgu s paralelnim promjenama u pogledu praga »boli«. Naše prethodno istraživanje pokazalo je da dugoročno opterećivanje ili fizički stres možda utječe na neke biokemijske spojeve i karakteristike ličnosti u pravcu emocionalne stabilnosti. Stoga bi endogeni opiodi možda bili eventualna karika između stresa proizvedenog vježbanjem i psihološke reakcije.

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SUMMARY

Two studies sought to determine the relationships between certain psychometrically assessed personality characteristics and selected biochemical compounds before and after a physical fitness program. In both studies the subjects were observed to undergo beneficial physiological changes since at the post-program test they exhibited more efficient cardiovascular performance as reflected by the significant results associated with the physical fitness scores.

Both the factor analytic and the canonical correlation results confirmed that the selected biochemical compounds were, in fact, related to personality characteristics.

Despite the conspicuous improvement in the physical fitness condition of the subjects, the relationships between the biochemical and personality variables did not change markedly over the four month period. Since the organism is always in a dynamic state of homestasis the slightly altered relationships between the two domains (observed at the post-test in the second study) may reflect such a mechanism. It would seem reasonable to speculate that a considerably longer and intensified period of regular (habitual) exercise is necessary to cause a dramatic change in personality parameters as demonstrated by the significant difference between high and low fitness group (observed in the first study).

РЕЗЮМЕ

Целью этих исследований было определение взаимоотношений между некоторыми характеристиками личности, измеряемыми при помощи психометрических методов и определенными биохимическими соединениями до начела и после выполнения программы повышения физической выносливости. Результаты показали, что в обеих исследованиях у испытуемых обнаружены положительные, физиологические изменения, так как после окончания программы у них улучшилась работа сердца и кровеносной системы, а также испытуемые получили большее число баллов в испытаниях физической выносливости.

Результаты факторного анализа, а также результатыканонической корреляции подтвердили, что выбранные биохимические соединения действительно связаны с характериотиками личности, согласно утверждениям Айзенка (Айзенк, 1964 г.).

Несмотря на явное повышение физической винослив ости испытуемых, взаимоотношения между биохимическими переменными и переменными личности не изменились существенно в течение четырехмесячного периода занятий. Так как организм всерда находится в динамическом состоянии гомеостаза, незначительно измененные взаимоотношения мейду этими двумя характеристиками (что было заметно после окончания программы занятий во втором исследовании) наверное и отражают такой механизм. Естественно предположить, что нужна более длительная и более интенсивная программа регулярной физической нагрузки для осуществления изменения параметров личности; об этом свидетельствует достоверная разница, полученная в первом исследовании между группами, обладающими хорошей и очень низкой физической выносливостью. Такое изменение может проявиться в результате значительных изменений химических условой в орианизме, так как физиологические и биохимические механизми и характеристики личности между собой неделимо связаны.

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BIOCHEMICAL BASIS OF PERSONALITY

INTRODUCTION

In an article which appeared in Science dealing with recent developments in neurobiology Kolata pointed out the difficulty of studying personality characteristics in humans because of lack of precision in the measurement techniques (Kolata, 1979). Yet she expressed her hope that resarchers someday make a connection between the neurobiological findings in animals and humans suspecting that some basic principles may universally apply. This paper is nothing but an humble contribution toward this goal. Studying the nature of human personality from both biochemical and psychometric approaches, it is hoped that communality could be found between the two approaches.

It is a well-known fact that true behavior, whether overt or covert, is biochemical in nature. By and large, the assessment of personality characteristics utilizing psychometric techniques, have been criticized for lack of precision. Consequently, by using selected biochemical correlates of personality in the assessment of personality characteristics, it is hoped that important information could be found relative to the accuracy of measuring personality characteristics and also some clarification could be provided as to the biochemical nature of such characteristics.

Research in the areas of animal and human endocrinology has provided evidence for the relationship between serum levels of several compounds and specific behavioral patterns. The compounds most frequently associated with emotional conditions are corticosteroids (Mason et al, 1968), catecholamines (Mason, 1968), glucose (Heaman et al, 1970; Koch & Molnar, 1974; Young & Ismail, 1975), cholesterol (Jenkins et al, 1969; Rahe et al, 1971; Sloane et al, 1961; Young & Ismail, 1975), and more recently, androgens (Rose, 1972).

Personality characteristics such as competitiveness and aggression (Sletten et al, 1964), extraversion (Sloane et al, 1961) and feelings of depression and fear (Rahe el al, 1971) have been shown to be associated with elevated cholesterol levels. The emotional conditions associated with high cholesterol levels may have cardiodynamic effects probably mediated by the catecholamines (Sloane et al, 1961). Catecholamines have been observed to be liberated in a variety of stress states (Euler, 1974; Konzett et at, 1971; Rao & Bhatt, 1972) and to reflect the intensity of emotional reaction (Frankenhaeuser, 1970; Schildkraut, 1965). InIcreased concentrations of circulating catecholamines have been found in patients with essential hypertension (Azelrod & Weinshilboum, 1972; Engelman et al, 1970; Wartman et al, 1970) and in the urine (Ghose et al, 1972) and plasma (Videbaek et al, 1972) of patients recovering from myocardial infarction.

Although sex hormones primarily influence sexual behavior, a clear role for testosterone has been established in aggression (Lee & Griffo, 1973; Payne & Swanson, 1972; Persky et al, 1971) and social behavior (Rose et al, 1972). Various stressful situations, in both animals and humans, have been shown to deplete testosterone secretion. These include surgical stress (Carstensen et al, 1972); climate (Briggs & Briggs, 1972); shock avoidance (Mason et al, 1968); and psychological stress (Kreuz et al, 1972). Further, recent evidence has related elevated testosterone in males to the increased incidence of coronary heart disease (Morse et al, 1968).

Recent evidence pertaining to the physiological, biochemical and psychological status of »normal« middle-aged men indicated that distinct personality differences existed between trained and untrained individuals. Further, the data suggested that participation in a four month physical conditioning program influenced not only physiological parameters but also personality characteristics, particularly those dealing with emotional stability (Ismail & Trachtman, 1973; Ismail & Young, 1973; Ismail & Young, 1975; Young & Ismail, 1975). Thus, the purpose of this paper is to investigate, in a multivariate fashion, the *relationships between* selected biochemical compounds and personality characteristics before and after a long-term exercise program. Specifically, the purpose of the study was to determine the effect of an exercise program on the relationships identified.

PROCEDURES

Two sequential studies were carried out to determine the relationships between personality characteristics and selected biochemical compounds. The first study was to explore whether or not such relationships do truly exist. Consequently, it was decided to factor analyze selected anthropometric, physsociological, biochemical and personality variables in order to examine the nature of the factor structure involving those variables. After examining the factor structure obtained, decision had been made at that time to proceed with second study. Since the factor structure showed that personality variables are loaded on the same factors with the biochemical compounds, it was resolved that the second study should deal with the degree to which personality characteristics and biochemical compounds are related. Furthermore, pre and post-physical fitness program data were collected to examine the effect of chronic exercise on the relationships identified.

Data were collected and analyzed using multivariate statistical procedures. In particular, factor ana-

lysis, canonical correlation, and discriminant function analysis were employed.

SUBJECTS

The subjects for both studies were Purdue University faculty and staff members and local businessmen between 21 and 61 years of age who volunteered to participate in a four month physical fitness program.

VARIABLES

In the first study data pertaining to the anthropometric domain were collected on chronological age (Age) and percent lean body weight (percent lean). Percent lean body weight was estimated using the method of Wilmore and Behnke (1969).

Physiological variables consisted of systolic (Syst) and diastolic (Diast) blood pressures — determined in the conventional manner; submaximal heart rate (SRH) — taken at the end of the ten minute treadmill walk, and physical fitness — using the criteria of Ismail et al (1965).

Biochemical variables were serum cholesterol — determined by the Hycel method of Stable Cholesterol Reagent Determinations, Hycel, Inc., Houston, Texas, and serum glucose assayed by the Harleco method, Harleco, Inc., Philadelphia, Pennsylvania.

The Eysenck Personality InIventory (EPI) (1963) was used to obtain the personality data during the first and final weeks of the program. Form A was used initially and Form B finally.

In the second study pre- and post- program data were collected on four biochemical variables selected because of their previously documented relationship to certain personality characteristics (Heaman et al, 1970; Jenkins te al, 1969; Mason et al, 1968; Rahe et al, 1971; Sloane et al, 1961; Young & Ismail, 1975).

1. Serum Glucose — determined by the procedure of Hultman (1959) as modified by Dubowski (1962) using reagents obtained from Hycel, InIc., Houston, Texas.
2. Serum Cholesterol — determined by the Hycel direct serum method, Hycel, Inc., Houston, Texas.
3. Serum Testosterone — determined by an adaptation of the radioimmunoassay technique described by Chen et al (1971) using reagents supplied by Wien Laboratories, Inc., Succasunna, New Jersey.
4. Free Catecholamines (epinephrine and norepineprine) — determined from a 24 hour urine sample using ionexchanged resin columns supplied by Bio-Rad Laboratories, Richmond, California.

In addition, the following personality variables were used:

1. Cattell 16 PF Questionnaire (16 PF) — Form A (1970)
2. Eysenck Personality Inoventory (EPI) — Form A (1963)

RESULTS

For the first study, the pre-and post- means and standard errors of the variables are presented in Table 1.

Four factors were extracted from the pre- and post-program data and they accounted for 70.54 and 69.48 percent of the total common variance, respectively. Complete results are presented in Tables 2 and 3.

Factor one is characterized by high pre- and post-loadings on submaxial heart rate, physical fitness and neuroticism. While neuroticism appears to be an important variable initially, it is somewhat reduced in importance in the final results in preference for age and percent lean. In this study, it would appear that the highly fit individuals tend to be older and represent an habitually active group. The factor was named *Physical Fitness and Emotional Stability.*

Factor two has high loadings associated primarily with systolic and diastolic blood pressures. It illustrates the relationship between blood pressure and physical fitness, and to some degree, emotional stability. Again, the importance of age in the post- program factor structure is evident. The factor was named *Blood Pressures and Physical Fitness Relationship.*

Factor three has high loadings on serum cholesterol both initially and finally. At the outset of the program high cholesterol levels were associated with obesity and extreme extraversion characterizing the typical endomorph. At the conclusion of the program high cholesterol levels appeared to be independent of personality dimensions. Instead elevated cholesterol is associated with ready energy such as glucose. The factor was defined as *Obesity and Extraversion.*

Intially, Factor four appears to characterize youthfulness, leanness and hypoglycemia while finally a new factor structure emerges which describes the neurotic introvert.

The discriminant function coefficients for the high versus low fit groups initially and finally are presented in Tables 4 and 5, respectively.

The pre- program results show the ability of the selected items in discriminating between high and low fitness groups. The coefficients revealed that neuroticism and percent lean, in that order, significantly discriminated between high and low fit groups with the high fit group demonstrating greater emotional stability and a higher percent of lean. The post-program results show that zero misclassifications were observed for each group. In this instance, percent lean and introversion, in that order, were found to be

the best discriminators — suggesting a decrease in the importance of the neuroticism-stability dimension of Eysenck's Inventory and an accentuation of a prominent physical fitness variable; namely, percent lean.

For the second study, the pre- and post- means and standard errors of the biochemical and personality variables are represented in Table 6.

The canonical correlations the percent of total possible variance and the weights associated with each correlation between the biochemical (p) and the personality (q) sets of variables are presented in Table 7. The relationships between the p and q sets for the pre- program data were significant at the ol level using the largest root and the summation of roots criteria.

The relative weights associated with the first canonical correlation indicated that the majority of the variance between the biochemical and personality sets was due to the relationships between testosterone and glucose and the personality variables: neuroticism, E (submissive vs aggressive) and C (emotional instability vs emotional stability). Examination of the univariate correlation matrix to ascertain the direction of relationships revealed that the pattern in this correlation indicates that individuals with high serum testosterone and glucose concentrations tend to be neurotic and aggressive.

The second canonical correlation indicated that the majority of the variance between the two sets was due to the relationship between glucose and cholesterol and G (expedient as conscientious, Q_4 (composed vs tense) and the conformity and neuroticism scales of the EPI. The pattern in this case suggests that high serum levels of glucose and cholesterol are related to low superego strength, tension, nonconformity and emotional instability. The data suggest that individuals with hyperglycemia and hypercholesterolemia are likely to be fickle, self-indulgent, disregarding of rules, undependable and to lack a drive to do one's best.

The third canonical correlation is similar to the second canonical and the weights indicated that the variance between the two sets was due to the relationships between serum cholesterol and glucose and the conformity scale of the EPI, C (emotional instability vs emotional stability) and Q_4 (composed vs tense). This pattern indicated that hypercholesterolemia and hyperglycemia are related to nonconformity, emotional instability and tension. Individuals, therefore, who are high on cholesterol and glucose are likely to be emotionally unstable and nonconformist. This canonical differs from the second canonical in terms of superego strength..

The fourth canonical correlation indicated that the majority of the variance between the two sets was due to the relationships between urinary catecholamine excretion and Q_4 (composed vs tense), neuroticism and G (expedient vs conscientious). This canonical showed that a high catecholamine excretion rate is related to neuroticism and tension.

The correlations between the biochemical (p) and the personality (q) sets of variables for the post- program data are presented in Table 8. The relationships between the sets were found to be significant at the .01 level using the largest root and the summation of roots criteria.

The canonical correlations found at the post- test were slightly different from those found at the pre-program test. Initially, glucose was the compound implicated most frequently in the four canonicals. During the final testing period, glucose was replaced by catecholamine excretion in this respect.

In the first canonical correlation, the relative weights indicated that the majority of the variance between the biochemical and personality sets was due to the relationships between urinary catecholamine excretion and serum testosterone concentration and the personality variables: O (secure vs insecure); neuroticism, and M (conventional vs bohemian). In this instance, a high catecholamine excretion rate when combined with a high serum testosterone level is related to neurotic aggression and unconventionality. Both pre- and post- program canonicals illustrate the relationship of catecholamine excretion to those personality traits characterizing neuroticism.

The second canonical correlation illustrated the relationships between serum cholesterol concentration and catecholamine excretion and G (expedient vs conscientious), M (conventional vl bohemian) and the extraversion scale of the EPI. The pattern observed in this correlation suggests that hypercholesterolemia and a high catecholamine excretion rate are related to low superego strength, unconventionality and extraversion.

The third canonical correlation revealed that the relationships were between serum testosterone and catecholamine excretion and neuroticism, O (secure vs insecure) and the lie scale of the EPI. This canonical supports the univariate correlation matrix and factor analytic structure in which high levels of testosterone and glucose are related to neuroticism and aggression. The same pattern was observed finally except for the shift to catecholamine excretion over glucose in the relationship.

The fourth canonical correlation indicated that the majority of the variance between the two sets was due to the relationships between serum glucose concentration and C (emotional instability vs emotional stability) and extraversion. In this instance, hypoglycemia was related to emotional stability and extraversion.

DISCUSSION

These two studies sought to determine the relationships between certain psychometrically assessed personality cahracteristics and selected biochemical compounds before and after a physical fitness pro-

gram. In both studies the subjects were observed to undergo beneficial physiological changes since at the post- program test they exhibited more efficient cardiovascular performance as reflected by the significant results associated with the physical fitness scores.

Both the factor analytic and the canonical correlation results confirmed that the selected biochemical compounds were, in fact, related to personality characteritics which support Eysenck's proposition (Eysenck, 1964). Comparison of the initial with the final results show that subtle changes occurred in these relationships — possibly as a result of the exercise program. Initially, individuals with high serum testosterone and glucose concentrations observed in the second study tended to be neurotic and aggressive. Aggression has been linked with testosterone secretion (Lee and Griffo, 1973; Payne and Swanson, 1972; Persky et al, 1971) and glucose with neuroticism (Stanaway and Hullin (1973); Young and Ismail, 1975). Stanaway and Hullin (1973) have suggested that the relationship between glucose and neuroticism as observed in the two studies may be due to the actions of epinephrine and the sympathetic nervous system in stimulating the release of glucose from the liver by the breakdown of glycogen.

The pre- test hypercholesterolemia and hyperglycemia were found to be correlated with self-indulgence and low superego strength, particularly in the second study. In contrast, at the post- test hypercholesterolemia was associated with catecholamine excretion. Serum lipids have been shown to be related to several personality traits (Rahe et al, 1971; Sletten et al, 1964; Sloane et al, 1961; Young and Ismail, 1975). Furthermore, in the first study, it was found that hypercholesterolemia vas associated with extraversion and obesity at the beginning of the physical fitness program but not at the end. In the second study, serum cholesterol and glucose were implicated with emotional stability and conformity initially but cholesterol appeared to be related to testosterone and a lack of physical fitness at the end of the program. Although cholesterol did not decrease significantly from pre- to post-test, its relationship t oother measures was altered possibly as a result of the conditioning program.

Urinary catecholamine excretion rate in the second study was found to be related to neuroticism and tension — especially at the post- test. This finding supports the catecholamine hypothesis of affective disorders, proposed by Schildkraut (1965), which is based largely on studies of urinary metabolites of catecholamines. The hypothesis implies that some, if not all, depressions are associated with a deficiency of catecholamines, patricularly norephinephrine, at functionally important adrenergic receptor sites in the brain.

Despite the conspicous improvement in the physical fitness condition of the subjects, the relationships between the biochemical and personality variables did not change markedly over the four month period. Since the organism is always in a dynamic state of homestasis the slightly altered relationships between the two domains (observed at the post-test in the second study) may reflect such a mechanism. It would seem reasonable to speculate that a considerably longer and intensified period of regular (habitual) exercise is necessary to cause a dramatic change in personality parameters as demonstrated by the significant difference between high and low fitness group (observed in the first study). Such a change would be the result of a significant alteration in body chemistry since physiological, biochemical and personality domains are inextricably interrelated.

Our future research will deal with the neurobiochemical compounds underlying personality and their relationships to chronic exercise. Previous research has indicated that certain endogenous opioids (β-endorphins and enkephalins) seem to function as neuromodulators and hormones with influence on neural areas responsible for »pain« perception, transmitter, respiration, motor integration, endocrine responses, and the limbic system that is involved with the elaboration of emotional states. Behavioral studies seem to indicate that stress increases the endorphin concentration in blood and brain with parallel changes in the »pain« threshold. Our previous research has shown that long term exercise or physical stress seems to influence certain biochemical compounds and personality characteristics in the direction of emotional stability. Hence, a possible link between exercise stress and psychological response may exist in the endogenous opioids.

Tabela 1 — Table 1

PROSJECI I STANDARDNE GREŠKE ZA PODATKE PRIJE I POSLIJE PROGRAMA UKUPNA GRUPA

MEANS AND STANDARD ERRORS OF THE PRE AND POST PROGRAM DATA TOTAL GROUP

		PRE *(prije)*		POST *(poslije)*	
		Mean *(prosjek)*	S.E. *(s.g.)*	Mean *(prosjek)*	S.E. *(s.g.)*
dob	1. Age	44.2	1.8	44.2	1.8
postotak mišićne mase	2. Percent Lean	81.5	1.0	82.4	1.0
sist	3. Syst	126.8	2.5	119.1	2.4
diast	4. Diast	80.9	1.8	77.0	1.9
SHR	5. SHR	106.9	3.1	102.6	2.9
PF	6. PF	345.1	10.1	370.5	9.0
kol	7. Chol	239.6	8.4	246.4	9.2
gluk	8. Gluc	93.7	1.9	95.8	2.4
E	9. E	9.9	8	12.8	8
N	10. N	7.3	1.0	8.9	1.0

Tabela 2 — Table 2

ROTIRANJE SATURACIJE FAKTORA PRIJE PROGRAMA STICANJA FIZIČKE KONDICIJE

ROTATED FACTOR LOADINGS FOR PRE PHYSICAL FITNESS PROGRAM

	Varijable Variables	F_1	F_2	F_3	F_4	h^2
dob	1. Age	.15	.08	.26	—.82	.78
postotak mišićne mase	2. Percent Lean	.29	—.51	—.34	—.48	.69
sist	3. Syst	—.13	.85	—.10	.03	.75
diast	4. Diast	—.11	.90	.01	—.07	.81
	5. SHR	—.82	—.02	.09	.24	.75
	6. PF	.74	—.45	—.18	—.05	.78
kol	7. Chol	—.15	—.10	.82	—.01	.70
gluk	8. Gluc	—.58	—.07	.02	—.55	.64
	9. E	.11	.06	.77	—.17	.63
	10. N	—.65	.27	—.17	—.03	.53
	Amount of Variance *količina varijance*	2.15	2.09	1.52	1.30	7.06
	Percent of Variance *postotak varijance*	21.55	20.83	15.16	13.00	70.54

Tabela 3 — Table 3

ROTIRANE SATURACIJE FAKTORA POSLIJE PROGRAMA STICANJA FIZIČKE KONDICIJE

ROATED FACTOR LOADINGS FOR POST PHYSICAL FITNESS PROGRAM

	Varijable Variables	F_1	F_2	F_3	F_4	h^2
dob	1. Age	.50	.51	.15	—.23	.58
postotak mišićne mase	2. Percent Lean	.76	—.31	—.03	—.02	.67
sist	3. Syst	—.14	.90	.00	.14	.84
diast	4. Diast	—.19	.84	.12	.06	.77
	5. SHR	—.82	—.11	.21	.04	.70
	6. PF	.83	—.30	—.21	.00	.82
kol	7. Chol	—.08	.10	.85	—.06	.74
gluk	8. Gluc	—.15	.02	.62	.20	.44
	9. E	—.08	.01	—.18	—.89	.82
	10. N	—.33	.37	—.08	.52	.52
	Amount of Variance *količina varijance*	2.39	2.11	1.27	1.16	6.93
	Percent of Variance *postotak varijance*	23.80	21.17	12.71	11.80	69.48

Tabela 4 — Table 4

DISKRIMINATIVNA ANALIZA PRIMJENOM ANTROPOMETRIJSKIH, FIZIOLOŠKIH, BIOKEMIJSKIH I VARIJABLI LIČNOSTI — DOBRA NASPRAM VRLO NISKE FIZIČKE KONDICIJE PRIJE PROGRAMA

DISCRIMINANT FUNCTIONS USING ANTHROPOMETRIC, PHYSIOLOGICAL, BIOCHEMICAL, AND PERSONALITY VARIABLES — HIGH vs. LOW PRE PROGRAM

	Variable *Varijabla*	Coefficients* for High vs. Low	*Koeficijenti za dobru naspram vrlo niske fizičke kondicije*
dob	1. Age		— .192
postotak mišićne mase	2. Percent Lean		1.554
sist	3. Syst		— .236
diast	4. Diast		— .117
	5. SHR		— .499
kol	6. Chol		— .093
gluk	7. Gluc		.509
	8. E		— .352
	9. N		—2.104
	Number of Incorrect Classifications for each group *Broj netočnih klasifikacija za svaku grupu*		1
	Mahalanobis D_2		9.4563
	Corresponding F-Ratio *Odgovarajućr F-omjer*		4.0017*

* All coefficients have been multipled by 100
* *Svi koeficijenti pomnoženi su sa 100.*
* Significant at. 05 level
* *Signifikantno na razini .05.*

Tabela 5 — Tabele 5

DISKRIMINATIVNA ANALIZA PRIMJENOM ANTROPOMETRIJSKIIH, FIZIOLOŠKIH, BIOKEMIIJSKIH I VARIJABLI LIČNOSTI — DOBRA NASPRAM VRLO NISKE FIZIČKE KONDICIJE POSLIJE PROGRAMA

DISCRIMINANT FUNCTIONS USING ANTHROPOMETRIC, PHYSIOLOGICAL BIOCHEMICAL, AND PERSONALITY VARIABLES — HIGH vs. LOW POST PROGRAM

	Variable *Varijabla*	*Koeficijent ÷ za dobru naspram vrlo niske fizičke kondicije*	Coefficients + for High vs. Low
dob	1. Age		— .530
postotak	2. Percent Lean		2.172
bezmasnosti	3. Syst *sist*		— .379
diast	4. Diast		— .008
	5. SHR		— .915
kol	6. Chol		— .146
gluk	7. Gluc		— .559
	8. E		—1.158
	9. N		— .374
	Number of Incorrect Classifications for each group	*Broj netočnih klasifikacija za svaku grupu*	0
	Mahalanobis D^2		10.1465
	Corresponding F-Ratio	*Odgovarajući F-omjer*	4.3046**

* *Svi koeficijenti pomnoženi su sa 100.*
** *Signifikatno na razini .01*

*All coefficients have been multiplied by 100
**Significant at. 01 level

Tabela 6 — Tabele 6

NORMATIVNI PODACI BIOKEMIJSKIH I ODABRANIH VARIJABLI LIČNOSTI PRILIKOM TESTIRANJA PRIJE I POSLIJE PROGRAMA FIZIČKE KONDICIJE

NORMATIVE DATA OF THE BIOCHEMICAL AND SELECTED PERSONALITY VARIABLES AT THE PRE-AND POST-PHYSICAL FITNESS PROGRAM TESTS

Varijabla Variable	*Prije programa* Pre-Test		*Poslije programa* Post-Test	
	X	S.E. *s.g.*	X	S.E. *s.g.*
Biochemical *Biokemijske*				
1. *Glucose (mg%)* glukoza	97.90	2.15	92.22	2.13
2. *Cholesterol (mg%)* kolesterol	206.38	4.80	197.95	5.50
3. *Testosterone (ng/100 ml)* testosteron	645.79	31.76	674.62	30.66
4. *Catecholamines (ug/24 hours (sati)* kateholamini	41.55	2.02	40.91	1.98
Personality *Ličnosti*				
1. faktor C	6.45	.27	6.66	.27
2. faktor E	5.74	.27	5.50	.23
3. faktor G	6.33	.26	6.21	.25
4. faktor M	6.93	.25	6.71	.22
5. faktor N	5.97	.25	5.81	.22
6. faktor O	4.36	.24	4.21	.27
7. faktor Q_4	4.83	.29	4.90	.29
8. Extraversion (EXT) *ekstraverzija*	10.33	.45	9.93	.49
9. Neuroticism (NEUR) *neurotičnost*	6.36	.64	6.17	.66
10. Conformity (LIE) *konformnost (laž)*	2.93	.21	3.03	.22

Tabela 7 — Table 7

ANALIZA KANONIČKIH KORELACIJA IZMEĐU ČETIRI BIOKEMIJSKE I DESET VARIJABLI LIČNOSTI PRILIKOM TESTIRANJA PRIJE PROGRAMA

CANONICAL CORRELATION ANALYSIS BETWEEN FOUR BLOCHEMICAL AND TEN PERSONALITY VARIABLES AT THE PRE-PROGRAM TEST

No. Broj	Variables *Varijable*	I	II	III	IV
1.	Glucose (mg%) *glukoza*	.43	—.65	—.64	—.28
2.	Cholesterol (mg%) *kolesterol*	—.31	—.60	.82	—.02
3.	Testosterone (ng/100 ml) *testosteron*	.92	—.08	.39	.19
4.	Catecholamines (ug/24 sati) *kateholamini*	—.04	—.10	—.35	.96
1.	faktor C	.59	.37	—.71	.20
2.	faktor E	.73	—.08	.36	.06
3.	faktor G	—.05	.72	—.33	—.50
4.	faktor M	.20	.36	.04	.25
5.	faktor N	.19	—.11	.14	—.34
6.	faktor O	—.05	.38	.04	.15
7.	faktor Q_4	.20	.58	—.51	1.23
8.	Extraversion (EXT) *ekstraverzija*	—.34	.02	.24	.43
9.	Neuroticism (NEUR) *neurotičnost*	1.01	—.48	—.07	—.89
10.	Confromity (LIE) *konfornost (laž)*	.37	.55	.77	.12
	Canonical Correlations *kanoničke korelacije*	.71	.46	.33	.27

Total related variance accounted for = 1.7654 out of apossible 4.0
Ukupna varijanca objašnjava 1.7654 od mogućeg 4.0
Percent of total possible variance accounted for = 44.13
Postotak ukupne moguće varijance objašnjava 44.13

Kriterij testa Test Criterion	Observed Value *Opsežna vrijednost*	Level of Significance *Razina signifikantnosti* .05	.01
O_4	.7054*	.4452	.5021
V^4	1.7654*	.9400	1.0488

m = 2.5. n = 21.0

* Significant at the .01 level
* *signifikantno na razini .01*

Tabela 8 — Table 8

ANALIZA KANONIČKIH KORELACIJA IZMEĐU ČETIRI BIOKEMIJSKE I DESET VARIJABLI LIČNOSTI PRILIKOM TESTIRANJA POSLIJE PROGRAMA

CANONICAL CORRELATION ANALYSIS BETWEEN FOUR BIOCHEMICAL AND TEN PERSONALITY VARIABLES AT THE POST-PROGRAM TEST

No. *Broj*	Variable *varijabla*	I	II	III	IV
1.	Glucose (mg%) *glukoza*	—.21	.17	—.25	—.93
2.	Cholesterol (mg%) *kolesterol*	.27	.96	—.19	.17
3.	Testosterone (ng/100 ml) *testosteron*	—.43	.08	—.88	.26
4.	Catecholamines (ug/24 sati) *kateholamini*	.78	—.48	—.43	—.13
1.	faktor C	—.28	—.19	—.12	.85
2.	faktor E	.20	—.12	.02	—.42
3.	faktor G	—.17	—.81	.25	—.34
4.	faktor M	.55	—.76	—.36	—.03
5.	faktor N	—.20	.47	.12	—.13
6.	faktor O	1.24	.06	—.50	—.32
7.	faktor Q_4	—.52	.13	.24	—.30
8.	Extraversion (EXT) *ekstraverzija*	—.39	.65	—.14	.71
9.	Neuroticism (NEUR) *neurotičnost*	—.78	—.46	—.58	.24
10.	Conformity (LIE) *konformnost (laž)*	.38	.02	.50	.47
	Canonical Correlations *kanoničke korelacije*	.51	.47	.43	.23

Total related variance accounted for = 1.6373 out of a possible 4.0
Ukupna odnosna varijanca objašnjava 1.6373 od mogućeg 4.0
Percent of total possible variance accounted for = 40.93
Postotak ukupne moguće varijance objašnjava 40.93

Test Criterium *Kriterij testa*	Observed Value *Opažena vrijednost*	Level of Significance *Razina signifikantnosti* .05	.01
O_4	.5136*	.9400	1.0488
V^4	1.6373	.4452	.5021

m = 2.5, n = 21.0

* Significant at the .01 level
* *signifikantno na razini .01*